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UDC 551.510.534(268)

Total Ozone Content Variability in Northern Circumpolar Space Determined Using Data From 'Sibir' Atomic Icebreaker Expedition (May- June 1987)

[Article by A. P. Nagurnyy and A. V. Shirochkov, Arctic and Antarctic Scientific Research Institute, Leningrad]

[Abstract] The first around-the-clock (each 3 hours) measurements of the total content of ozone in Arctic circumpolar space were made in May-June 1987 during a cruise of the "Sibir" atomic icebreaker. It was possible to discriminate at least two characteristic regimes of ozone variability, each of them with a definite type of intradiurnal and day- to-day variations. The transition from one type to another along the ship's track was rather sharp. On the first part of the track, from Murmansk to drifting station SP-27, there were unusually great intradiurnal changes in total ozone content, with exceedingly low minimal values. After departure from SP-27 (86°N) the "Sibir" registered a sharply reduced ozone content (less by a factor of 5.6 than on the first part of the track) and there was a poorly expressed mean diurnal variation. All these observations were accompanied by registry of the time variability of the index of planetary geomagnetic disturbance A_p, which together with total O_3 content was averaged for three-day periods. In all cases there was a distinct correlation between these two variables. An attempt was made to explain the nature of this correlation along different segments of the ship's track (the first segment was in the auroral region of radiation belt leakage, the second in the polar cap region where the nature of leakage is quite different). The radiation belt of high-energy electrons reduces total ozone content due to a decrease in the number of ozone molecules at the middle and upper levels of the stratosphere in the auroral zone. Figures 2; references 4: 2 Russian, 2 Western.

UDC 551.510.534:551.465.15:551.511.61

Diffusion of Impurities in Field of Strong Eddy and Antarctic 'Ozone Hole' Problem

[Article by S. G. Chefranov, candidate of physical and mathematical Sciences, Atmospheric Physics Institute]

[Abstract] Precise analytical solutions of the problem of diffusion of a finite quantity of an impurity in a regular velocity field are available only for the simplest regular shear currents with a linear velocity profile in space variables. In this article an analysis is made of the advective mechanism of formation of the Antarctic "ozone hole" using a precise solution of the problem of turbulent diffusion of an impurity in a regular spatially nonlinear velocity field created by an isolated vortical center. In the proposed relatively simple model the appearance of an ozone minimum in spring may be associated with the presence of specific katabatic advection in the polar latitudes. The systematic decrease of the ozone minimum observed from year to year is possibly attributable to climatic changes in the nature of atmospheric circulation in the polar Antarctic zone. The appendix examines the possibility of using this solution in other problems of practical importance, such as the meteorological interpretation of satellite photographs of spiral structures in the cloud layer and also for evaluating the influence of turbulent diffusion and river runoff on the transport of impurities in the shelf zone of the sea. Figure 1; references 23; 18 Russian, 5 Western.

UDC 550.837

Bottom Deep Magnetotelluric Soundings in Northeastern Pacific Ocean

18650161 Novosibirsk TIKHOOKEANSKAYA GEOLOGIYA in Russian No 6, Nov-Dec 88 (manuscript received 30 Sep 87) pp 95- 99

[Article by N. A. Palshin, Oceanology Institute, USSR Academy of Sciences, Moscow]

[Abstract] A series of deep magnetotelluric soundings was carried out by American specialists in the northeastern Pacific Ocean during the 1970's (a map of the surveyed areas, designated NCP, S. F. Rev. and ROSE-1B, accompanies the text). The collected data were interpreted using the mean geometrical values of the principal components of the impedance tensor. These materials have now been reexamined by two- and three-dimensional modeling for the purpose of taking into account the influence of near-surface inhomogeneities. The least distorted impedance components are discriminated. A further analysis and correction of the experimental data were used in an interpretation which indicated a closeness of the geoelectric sections for the entire investigated region from the Hawaiian Islands to the East Pacific Ocean Rise. A unified geoelectric model of the region was constructed which revealed an anisotropy of lithospheric conductivity. Figures 5; references 15: 6 Russian, 9 Western.

UDC 550.348.098

Catastrophic Earthquake in Armenia in 1988: Analysis of Seismic Conditions in Focal Region

18650194a Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 5, May 89 (manuscript received 20 Jan 89) pp 72-77

[Article by N. V. Kondorskaya and I. V. Gorbunova, Earth Physics Institute imeni O. Yu. Shmidt, USSR Academy of Sciences]

[Abstract] A historical review is given of seismicity in the neighborhood of the Spitak (Armenian) earthquake of 1988 for the years 550-1977, with special attention to seismic conditions from 1978 to 1987. Information is given on the strongest earthquakes occurring in the Soviet Caucasus and adjacent regions of Turkey and Iran. [All these data are represented in a series of maps accompanying the text.] During the four years prior to the Armenian earthquake there was a decrease in seismic activity in virtually all regions of the Caucasus, other than the eastern part of the Lesser Caucasus. In the second quarter of 1988 there was a greater activation of the eastern part of the Caucasus with some westward movement. At the epicenter of the Spitak earthquake of 1988 there were three earthquakes with a magnitude 3-4. An analysis of seismic conditions in the epicentral zone of the last earthquake indicates an interrelationship between seismic activity in Armenia and adjacent regions of Turkey. Manifestations of seismicity are consistent with seismotectonic conditions in this region, characterized by the presence of faults of sublatitudinal and meridional strike. Figures 4; references 17: 16 Russian, 1 Western.

UDC 528.47:65.011.56

Automated Measurement Complex Based on 'Priboy' Radiogeodetic System

90A40008 Moscow GEODEZIYA I KARTOGRAFIYA in Russian No 6, Jun 89 pp 40-44

[Article by G. G. Pobedinskiy, V. T. Zvyagintsev, V. F. Stroyev (deceased), A. A. Genike, M. I. Vernitskiy and V. V. Zlotin]

[Text] A number of automated measurement complexes have been developed during recent years both in the Soviet Union and abroad [4, 6]. However, many of them are great in size and weight, high in required power and are usually oriented on the use of specially outfitted ships of considerable displacement. Such outfits are ill-suited for operation in inland water bodies and in the coastal zone where small ships (launches, motor boats, rowboats, etc,) are used as the carrying craft. On-shore optical theodolites or pulsed laser range finders, in combination with such instruments for measuring depths as graphic echo sounders and measuring rods, are used for the most part in measurement work in inland water bodies. The processing of the measurement results is usually carried out manually. This substantially reduces the efficiency of use of such technical apparatus as radiogeodetic systems with digital output devices and digital echo sounders. Field subdivisions have a need for an outfit which would be characterized by economy, simplicity in servicing and a high level of automation of the entire measurement process.

In 1987 the "initiative" group of specialists at Enterprise No 7 and the Central Scientific Research Institute of Geodesy, Aerial Photography and Cartography, on the basis of the "Priboy" radiogeodetic system and the ATOS automated topographic system, developed a portable automated measurement complex for inland water bodies. Figure 1 is a general block diagram of the complex. [Fig 1 and subsequent graphics not reproduced]

The outfit consists of two main parts:—field measuring-recording complex mounted on the measuring ship and at survey horizontal control points;—complex for decentralized data processing set up at the party field base.

The horizontal position of the ship in the considered complex is determined by the method of linear intersection from two points using the "Priboy" radiogeodetic system (RGS) [1]. The RGS consists of a dual shipboard station, intended for determining two measured ranges in both range finder and log modes, and two on-shore stations serving as active relay units for exchanging signals with the on-board RGS complex. The effective

range for each range finder channel is 25-30 km. The rms error in determining range in each channel is plus or minus 1 m. The RGS operates in the 3-cm radio wave range. All the system stations are supplied current from 12-V storage batteries. The power consumed by the dual on-board station is 160 W; that required by an on-shore stations is 60 W. The RGS can operate both independently and in combination with other constituent parts of the measurement complex. The remote transponders at the shore stations are mounted on tripods or masts with a height up to 25 m (in order to increase the range of direct visibility) and indicator units are positioned in places convenient for the operators. They can also be placed in tents. Figure 2 shows the general appearance of an on-shore station. The remote transponder units at the on-board stations have a coaxial construction and are attached to a special mast or on a tripod mounted on the roof of the wheelhouse on the measuring ship (see Fig. 3). The indicator units of the on-board stations are usually placed in the wheelhouse.

The RGS stations are controlled from a control panel situated on the front panels of the indicator units. A log mode is the principal RGS operating regime. It makes it possible to trace and indicate the measured ranges. A rangefinding mode is used for the independent registry of the full values of the measured ranges at the beginning and end of eah survey run, as well as after possible brief loss of the signal in one of the two range finder channels. The current range values are fed out in a series-parallel four-digit standard binary-decimal code into a data recorder of the RION type by a command arriving from the coupling unit.

Figure 2. General appearance of "Priboy" on-shore RGS station.

Figure 3. Remote transponders of on-board stations mounted on roof of measuring ship wheelhouse.

In order to register data in digital form from echo sounders of the analog type specialists at Enterprise No 7 developed a digital block which includes: shaper of a rectangular signal whose duration is proportional to measured depth; quartz generator of quantizing pulses with frequency dividers; generator of indication and interrogation frequency; depth counter; registers; commutator; digital indication unit and unit for coupling with external devices.

A small modified "Yaz" echo sounder, designed for measurements on rivers and lakes, was used as an analog echo sounder. The modification was as follows: the echo sounder was fitted with a digital unit for work at small depths under conditions of double and triple reflections of signals; the measurement accuracy and its noise immunity were increased.

A coupling unit was developed for connecting the RGS channels and a digital echo sounder to a data recorder. The unit includes an interrogation commutator, timer, counter of synchropulses and word separator code shaper.

A standard-produced single-channel portable data recorder (RION) was used as the recorder of the results of shipboard measurements. It is intended for the registry of digital data into an electronic memory and its temporary storage. There is also a cassette data storage unit (NIK) for rerecording the data from the RION to magnetic tape in an MK 69 compact cassette [2].

Figure 4 is a block diagram of the complex for decentralized processing of the measurement results. Over a period of years this complex has been employed by production subdivisions and has been adequately debugged. It consists of an "Elektronika" DZ-28 minicomputer, thermal printing unit, LKD-4 portable analog curve plotter and a unit for coupling the computer to a portable curve plotter. The data for processing and drafting are introduced directly from the keyboard manually or automatically using the RION or NIK. The program for control of the GRAF portable plotter consists of such subprograms as movement of the uplifted pen to a point with stipulated coordinates, drafting of a coordinate grid, plotting of digits, input of coordinates and depths from the keyboard or a magnetic tape, registry of coordinates on magnetic tape, output of an overlay of depths at a stipulated scale to the plotter.

The following programs were prepared for processing the measurement results: "Pechat" ["Print"] (for printout of data registered in the RION) and "Katalog-massiv" [Catalogue-file] (for processing the measurements and registry of the determined coordinates and depths on magnetic tape).

In the course of debugging of the complex the technology of processes for the collection, processing and display of data was made more precise. Operational data (date, time, number of run, etc.) are registered manually using the corresponding identifiers; the measurement data are registered automatically at each reading point in the form of a series of digits, including digital information for two visibility ranges read out from the RGS, and information on the measured depth, which is read from the echo sounder digital unit. The total volume of registered information for one measurement point is 20 symbols. The operational modes of the "Priboy" RGS and the digital echo sounder ensure a possibility for automatic registry of the measurement results at any moment in time.

In order to check the operational capabilities of the measurement complex under field conditions the principal processes involved in the surveying of inland water bodies at a scale 1:10 000 were tested, the reliability of the functional relationships of all the technical apparatus used in the complex was evaluated and data were collected in a volume necessary for debugging the entire technological process.

The work results made it possible to conclude that there is an adequately efficient interaction among the component parts of the complex and reliable registry of measurements.

The field work was carried out in August-September 1987 in Rybinsk Reservoir. The shore stations were situated at points selected in such a way that with one positioning it was possible to survey a sector coinciding with a sheet at a scale 1:10 000. The transponders were mounted on 16-m telescopic masts. The indicator units of the on-board RGS stations were positioned directly in front of the wheelhouse, whereas the support with the coupling unit, echo sounder and the data storage unit were in front of the operator.

Trial runs made after the installation of the on-board apparatus once again made it possible to check the interaction among all the units and assemblies of the measurement complex, to select the optimal depth of submergence of the echo sounder vibrator and to check the performance of the "Priboy" RGS at ranges close to the limiting distances (up to 20 km or more). The results of range measurements registered dynamically when making runs between points with known coordinates were compared with the results of measurements of these same ranges in a static mode and with the range values computed using the coordinates of the end points. The maximal discrepancy of the results obtained in the course of the measurements and also computed from the coordinates was 0.6 m.

The survey lines were run in an equidistant pattern, that is, a constant range value was maintained along the entire extent of the run using one of the range finder channels. The distance between the runs was approximately 150 m.

In order to ensure a uniform density of the measurement points over the entire area of the survey sector the interrogation of the measurement apparatus and the registry of readings were accomplished at a constant time interval of 20 s, fixed by a timer (the apparatus can be interrogated with any time interval in the range from 3 to 90 s). With an average rate of movement the ship during this time moved 50-60 m along the survey line.

The distances measured in the course of the survey were from 12.4 to 16.0 km with respect to the radii of the survey runs and from 4.6 to 10.7 km for the ranges along the runs.

Data in the RION were put into the form of files corresponding to each run and then were rerecorded for long-term storage on magnetic tape using the NIK. Data files were thereby accumulated which usually corresponded to one working day (from 200 to 500 survey points).

The ranges from the shore stations, precomputed from the coordinates, were used for directing the ship to the stipulated point in the water body and maintaining it on course.

Experience has shown that without special efforts it is possible to adhere to the stipulated course with an accuracy to about 15-20 m.

A total of 24 survey lines were run during the period from 15 August to 5 September 1987 and the coordinates of about 1400 points were determined.

The programs and the capabilities of the decentralized complex for the processing of the collected data made it possible to perform all the preliminary processing procedures called for in the instructions [3] in an automated mode. The only exception was a comparison of depths at the points of intersection of survey and control runs.

Without dwelling in detail on the special features of the algorithms and programmed solutions, it must be noted that the introduction of formalized checking of the measurement results made it possible to detect virtually all the blunders associated with malfunctions of both the measuring and registry apparatus. During the processing procedure about 15

of the information was discarded. However, due to its excess (2 or 3 times more measurement points were registered than required) there were no information gaps present for the considerable sectors.

A detailed analysis of the results of processing of echo sounder readings by means of comparison of the readings of the digital unit and an ordinary analog record (this was possible due to the presence of operator's marks on the echogram at each moment of registry of readings from the digital unit) made it possible to draw the important conclusion that in most cases the replacement of a continuous profile by discrete values is entirely admissible and does not lead to distortions in the representation of underwater relief.

It goes without saying that this conclusion is not universal because both the optimal interval of depth registry on the run and the distances between runs are essentially dependent on the complexity of bottom relief. Nevertheless, the considered survey technology can be used with any degree of complexity of bottom relief because in case of necessity the discrete information received in the course of measurement work can be supplemented without particular difficulty in the preliminary processing stage due to the availability of a parallel analog record of echo sounder readings.

After analyzing the method described above it must also be noted that although in the processing of the measurements we obtain all the materials called for in the instructions [3] (summaries of measurements, catalogue of coordinates and depths, depths overlay, etc.), in the future the need for this will disappear because the registry of all the metric data on a computer-readable carrier (MK 60 compact cassette) is only the first step in constructing a digital relief model.

We feel that the structure of the automated measurement complex and the technology for a topographic survey of inland water bodies corresponding to it fully meets the requirements of modern topogeodetic production.

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Reserves for increasing operating reliability of both the entire complex and its individual components were revealed in the course of implementation of field research. In addition, ways have been envisioned for further automation of the process of resolving ambiguity in the measured ranges in the RGS, in sampling depths with the digital echo sounder and in solving navigation problems on shipboard using a microcomputer.

The experience in developing the measurement complex is evidence of the great possibilities for close cooperation among scientific research and production teams.

Bibliography

1. Vernitskiy, M. I. and Genike, A. A., " 'Priboy' Radio-geodetic System and Results of its Tests," BTI (Bulletin of Technical Information), No 1 (126), pp 9-11, 1987.

2. Vtyurin, A. N. and Timofeyev, A. N., "Apparatus for Registry of Topogeodetic Information," GEODEZIYA I KARTOGRAFIYA (Geodesy and Cartography), No 8, pp 43-45, 1986.

3. "Instruktsiya po Sozdaniyu Topograficheskikh Kart Shelfa i Vnutrennikh Vodoyemov" (Instructions on Compilation of Topographic Charts of the Shelf and Inland Water Bodies), GKINP-11-152-85, Moscow, TsNIIGAiK, 1985, 158 pages

4. Kamornyy, V. M., Sviderskiy, M. M. and Molin, V. G., "Automated System for Collecting Data in Shelf Survey," GEODEZIYA I KARTOGRAFIYA, No 4, pp 43-47, 1987.

5. Pobedinskiy, G. G., "Automation of Collection and Preliminary Data Processing in Topographic Survey of Shelf," TR. TsNIIGAiK (Transactions of the Central Scientific Research Institute of Geodesy, Aerial Photography and Cartography), No 238, pp 104-116, 1984.

6. Balandin, V. N., Borisov, L. A., Volodarskiy, R. D., et al., "Sredstva i Metody Topograficheskoy Syemki Shelfa" (Apparatus and Methods for Topographic Survey of Shelf), Moscow, Nedra, 1979, 296 pages.

UDC 534.21

Dislocations of Phase Front in Oceanic Wave Guide and Their Manifestation in Acoustic Measurements

[Article by V. A. Zhuravlev, I. K. Kobozev and Yu. A. Kravtsov, General Physics Institute, USSR Academy of Sciences]

[Abstract] Research on phase front dislocations in oceanic wave guides is important because the position of the field zeros makes possible a qualitative understanding of the behavior of the field phase as a function of coordinates in the entire considered region. The presence of field zeros and phase front dislocations must be taken into account when interpreting the results of phase measurements in experiments with acoustic sounding of the ocean because the phase gradient of the total field in the neighborhood of dislocations is substantially greater than in other parts of the wave guide and the phase gradient field tends to infinity directly at the point of a zero field. A study was made of the generation of phase front dislocations in a wave guide with a small number of modes. It is demonstrated that the distribution of dislocations in the wave guide section is nonuniform. The movement of dislocations caused by a tide is examined and a numerical example is used in illustrating the nature of change in the field phase with the passage of dislocations near the receiving antenna. In multimode wave guides the existence of field interference zeros and phase front dislocations is probably the rule rather than the exception (a formula is derived for determining the density of jdislocations). Figures 5; references 6: 4 Russian, 2 Western.

UDC 534.222

Model Investigations of Modal Structure of Field of Parametric Radiator in Acoustic Wave Guide

[Article by V. Yu. Zaytsev, V. V. Kurin and A. M. Sutin, Applied Physics Institute, USSR Academy of Sciences; Gorkiy State University imeni N. I. Lobacheskiy]

[Abstract] An experimental study of the modal structure of the field of a parametric radiator in an acoustic wave guide was made. Time selection was used for discriminating individual modes. The radiated pulsed signal, due to intermode dispersion, decayed into a number of pulses, each of which corresponded to its wave guide mode. This analysis method made it possible to investigate the modal structure of the radiated field, to determine the dependence of the intensity of radiation on wave guide depth, the conditions for the optimal excitation of individual modes and the angular distribution of the fields in different modes. The model developed by V. Yu. Zaytsev, et al. (AKUST. ZHURN., Vol 33, No 1, pp 37-42, 1987) was used in a theoretical description of the observed effects. The measurements were made in a regime of traveling waves in a flume with a width 0.7 m and a length 6 m with a depth of the water layer varying in the range 35-200 mm. It is shown that the excitation of definite wave guide modes is possible using a parametric radiator. An optimal angle of inclination of the radiator exists for each of these modes. Due to the difference in the angular structure of the modes, for a multimode signal the angular jdistribution of field level is dependent on the depth of positioning of the receiver and its distance from the source. The use of the mentioned model made it possible to explain the fundamental laws of field formation and to obtain a fairly good quantitative agreement between the experimental results and computations. Figures 4: references 10: 9 Russian, 1 Western.

UDC 534.2

Spatial Distribution of Field in Neighborhood of Caustic Forming During Sound Scattering by Vortex Velocity Field

[Article by V. V. Klimov]

[Abstract] The influence of vortices on sound scattering is governed by two mechanisms. The first is the mechanism of scattering on inhomogeneities of the refractive index and the second is scattering on the vortex velocity field. The results of solution of the model problem of sound scattering by the velocity field of an axisymmetric vortex with spatially limited vorticity are presented. The problem is solved using a method similar to the phase screen method and an attempt is made to describe the field after scattering on a Hill vortex, also correct in the neighborhood of a caustic. The basis for the proposed approach is the fact that immediately after the vortex the field is correctly described by the geometrical acoustics approximation and that outside the vortex core the field satisfies the Helmholtz equation. Taken together these facts make it possible to determine the field in the entire half-space behind the Hill vortex. The results are represented in asymptotic and graphic forms. In full accordance with an analysis in the modified geometrical acoustics approximation, the Hill vortex, oriented along the wave vector of the incident wave, has focusing properties. A relatively simple solution of the problem can be found due to spatial limitation of the vorticity region. The proposed method can therefore be easily extended to other axisymmetric vortices with spatially limited vorticity, such as to Kelvin vortices. Figures 5; references 10: 9 Russian, 1 Western.

UDC 534.222

Dynamics of Hydrostructures in Field of Acoustic Wave

[Article by M. Yu. Romanovskiy, General Physics Institute, USSR Academy of Sciences]

[Abstract] A study was made of "self-clearing" fluids in which the coefficient of sound absorption decreases in amplitude and sound penetrates farther into the fluid under the influence of an acoustic field. An analysis was made of the physical mechanisms involved and the classes of substances in which the appearance of such hydrostructures is possible are discussed, followed by a determination of the values characterizing their propagation. It is shown that several types of structures can be maintained in an ultrasonic beam with a power of several watts. First, a thermal wave of acoustic "clearing" is possible in highly viscous fluids of the glycerin type with a considerable temperature dispersion of viscosity. Second, in non-Newtonian fluids with rheologies not dependent on time the developing regions of fusion may be propagated in the hardening matter. Third, there may also be movement of vortices, existing in a Newtonian medium, interacting with an acoustic beam. The developed theory makes it possible to estimate the velocity of propagation of these structures, for which there is usually a lower limit. Their velocity of propagation in an ultrasonic beam with a power of several watts is fractions of a cm/s. References 20: 18 Russian, 2 Western.

UDC 551.46.0

Mechanism of Formation and Possibilities of Using Brightness Maximum Near 700 nm in Emission Spectra of Water Bodies for Remote Sensing

[Article by A. A. Gitelson and K. Ya. Kondratyev, academician, Hydrochemical Institute, Rostovna-Donu; Limnology Institute, USSR Academy of Sciences, Leningrad]

[Abstract] The mechanism of formation of the spectral maximum of ascending radiation near 700 nm is clarified. The spectral brightness coefficients of different water bodies (Sea of Azov, Don River, Lake Balaton, etc.) measured from a ship or helicopter were investigated. The concentrations of the principal optically active components were measured synchronously: chlorophyll concentration, suspended matter and dissolved organic substances. The position of the maximum was determined in the range of wavelengths from 600 to 800 nm in the luminescence spectra of water samples. It was registered in all spectra at a wavelength 685 nm; its position did not change with variation of the chlorophyll concentration. The maximum near 700 nm with chlorophyll concentrations greater than 1 mg per cubic meter is caused by light absorption by phytoplankton pigments and therefore by the minimum in the absorption index spectrum. There is an extremely close correlation between C_{chl} and γ_{max}. This correlation makes it possible to make remote estimates of concentrations of chlorophyll and phytoplankton on the basis of γ_{max}. In the range of concentrations from 5 to 100 mg x m^{-3} a determination of C_{chl} is possible with a standard error of the estimate less than 10 mg x m^{-3}. Figures 4; references 13: 10 Russian, 3 Western.

UDC 534.24;534.87

Acoustic Methods in Marine Navigation

[Article by L. M. Brekhovskikh, V. I. Volovov, V. V. Krasnoborodko and Yu. P. Lysanov, Acoustics Institute imeni N. N. Andreyev, USSR Academy of Sciences; Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences]

[Abstract] New possibilities have appeared for solving navigational problems when using multielement plane receiving antenna arrays. Joint analysis of the variability of the acoustic field in the antenna aperture and in time makes possible autonomous determination of ship displacement from a stipulated point with a high accuracy using spatial fluctuations of the amplitude of signals reflected from the bottom. The "Plast-2" system developed for this purpose is described. Using this array the measurement error can be reduced to several centimeters regardless of the ship's speed and local depth. Ship displacement can also be measured by the correlation log method, which differs considerably from the described method since in the first case the measured parameter is the time interval from which there is conversion to the traversed distance on the basis of the known speed, whereas in the second the measured parameter is the directly traversed distance. The error in measuring speed in correlation log systems, and therefore in measuring distance, is dependent on speed itself and increases with its decrease. In the described measurement systems the displacement error has an absolute character and is not dependent on speed; displacement measurements at low speeds therefore have a quite high accuracy. The great duration of radiation when working with the correlation log results in averaging of speed during measurement and therefore is virtually useless in the case of small sign-variable ship speeds. The proposed method makes measurements possible "at a point." The multielement spatially separated receiving antennas are now being used in solving navigational and oceanological problems,

such as on the "Akademik Sergey Vavilov" scientific research ship. Figures 5; references: 11 Russian.

Acoustic Emission Tomography of Ocean

[Article by I. N. Didenkulov and A. G. Nechayev, Applied Physics Institute, USSR Academy of Sciences]

[Abstract] Noise field tomography is used in reconstructing the spatial distribution of the parameters of noise sources (emission tomography). Integral equations are derived relating the intensity of the acoustic field and the spatial distribution of the noise sources. A spectro-tomography scheme is examined. As simplifications a study is made of a horizontally homogeneous layered ocean with an arbitrary vertical speed of sound profile; sea waves are considered quasihomogeneous; the restructuring of the speed of sound profile caused by synoptic variability is considered insignificant and its influence on change of the energy spectrum of noise field modes is also neglected. The efficiency of the method is evaluated with these simplifications taken into account. As an illustration, known experimental data are used in reconstructing the spatial distribution of shipping noise. Figures 4; references 13: 10 Russian, 3 Western.

Observation of Hydrodynamic Instability in Ocean

[Article by N. A. Panteleyev, A. N. Shcherbakov and Ye. N. Shcherbakova, Marine Hydrophysics Institute, Ukrainian Academy of Sciences]

[Abstract] An experiment was carried out in the Atlantic Ocean on the 33d cruise of the "Akademik Vernadskiy" research ship (February-May 1986) for collection of data on shear instability in the ocean. Three automatic buoy stations were used, separated by a distance 1-3 km; the duration of measurements was 96 hours. This experiment made it possible to trace successive stages in the development of shear instability under real conditions in the ocean and to determine the principal spatial and temporal parameters of the phenomenon. An instability region arises as a result of the joint influence of a shear flow and internal waves of different scales. The relative contribution of different movements to the generation of critical velocity shear in the considered case can be estimated as follows: mean flow 25%, inertial oscillations 50%, tidal oscillations 5%, 70-minute waves 15% and the remaining small fraction is attributable to the influence of internal waves of other scales. Supercritical velocity

shear leads to a rapid increase in unstable disturbances having the form of a well-expressed packet of short-period intensive oscillations. This evidently leads to collapse of the packet, which results in formation of a zone of mixing with approximate dimensions 400 x 400 x 6 m. Soundings carried out at the corresponding moment in time reveal a two-layer structure of the thermocline with a discontinuity in the middle, a narrow layer with a reduced local density gradient. The experimental data are consistent with the theoretical results obtained on the basis of a simple model of development of unstable disturbances in the case of non-plane-parallel and nonstationary velocity shear. Figures 3; references 15: 8 Russian, 7 Western.

Wave Energy Scattering on Shoreline

[Article by V. V. Ivanov and V. N. Kramushin, Marine Geology and Geophysics Institute, Far Eastern Scientific Center, USSR Academy of Sciences]

[Abstract] This study makes use of the results of a mathematical analysis of wave propagation in a channel with wave energy leakage on the walls (F. Raichlen, et al. in "Tsunami: Their Science and Engineering," 1983), but expands on it since that study had serious shortcomings. On the basis of an analysis of observational data on propagation of the Chilean tsunami of 22 May 1960 in the internal Sea of Japan it is concluded that there is a substantial attenuation of the high-frequency energy of the wave as a result of propagation. Specifically, an analysis was made of the dependence of the duration of the impulse function on the length of the path traveled through the strait. It was found that this value increases approximately proportionally to the square of distance. This increase is attributable to dissipation of high-frequency wave energy. The dissipation is interpreted as a result of leakage of wave energy on the shoreline caused by scattering on shoreline inhomogeneities. Figures 5; references 11: 8 Russian, 3 Western.

Measurements of Longitudinal Coherence in Short-Period Wind Generated Sea Waves

[Article by G. N. Khristoforov, A. S. Zapevalov and V. Ye. Smolov, Marine Hydrophysics Institute, Ukrainian Academy of Sciences]

[Abstract] The structure of the statistical correlation in high- frequency wind waves is investigated on the basis of experimental data. Special research was carried out in the sea in the poorly studied range of short wind waves and these data were compared with laboratory data in the same range of scales. There are substantial differences between laboratory and sea wind waves in the decimeter and meter ranges; the longitudinal coherence in laboratory waves persists at distances up to 1-2 wavelengths, whereas in sea waves it disappears at distances less than half the wavelength. The loss of coherence in sea waves is attributable to the influence of the large-scale components of the spectrum of wind waves. The most probable mechanism may be interaction between high-frequency waves and orbital currents of longer dominant waves and a turbulent drift current near the sea surface. The disappearance of coherence should lead to an attenuation of those mechanisms of interwave interaction in the sea which occur due to satisfaction of synchronism conditions in surface waves. The nonlinear resonance interaction of surface waves with internal waves, having a phase velocity equal to the group velocity of surface waves, can be considered a modification of synchronous interaction. Figures 4; references 14: 7 Russian, 7 Western.

UDC 551.466.81:551.465.8

Transformation of Spectra of Internal Waves in Horizontally Inhomogeneous Large-Scale Currents

[Article by S. I. Badulin and V. I. Shrira, Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] A semiempirical model of transformation of the spectrum of internal waves in the upper layer of the ocean is proposed which is based on the hypothesis of the existence of a universal component of the field of internal waves. The mechanism of formation of distinct features (peaks, plateaus) in the spectra of internal waves, based on a competition of processes of transformation of the field of internal waves in the current and its relaxation to an equilibrium state, is examined. The possible experimental checking of the proposed model is discussed. Measurement of the spatial spectra in the problem of the transformation of internal waves by currents is clearly preferable to the measurement of frequency spectra. The use of frequency spectra results in the averaging of the contributions of internal waves differently sensitive to horizontal inhomogeneity, which makes the interpretation of the experimental results difficult even at the qualitative level. The proposed model can be effectively used for the development of methods for the experimental study of the dynamics of the field of internal waves in the ocean, especially the relaxation characteristics. The simplicity of the model makes its use possible in operational prediction of the

state of the field of internal waves using data on large-scale currents. With further development the model can be used as a basis for developing methods for remote sounding of large-scale currents. Figures 3; references 11: 7 Russian, 4 Western.

UDC 551.465.555

Influence of Effective Vertical Viscosity on Horizontal Velocity Shear in Internal Wave

[Article by V. P. Maslov, Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] In computing the lower modes of internal waves it is customary to neglect viscosity (both molecular and effective turbulent). However, in the fine-structured profile of density and currents effective vertical viscosity may exert a significant influence on the fine-structured part of horizontal velocity shear in an internal wave and therefore on the local Richardson number, although other internal wave parameters may remain constant. The influence of viscosity can be computed as a correction to the main solution without allowance for viscosity. This is illustrated in the example of short internal waves. A model of the pycnocline in an unbounded fluid was examined. Since the length of the viscous wave may be one or two orders of magnitude greater than in the absence of currents, an appropriate expression is derived for the field of a viscous wave in this case. Formulas are given for the total horizontal velocity shear with allowance for viscosity. It is shown that with sharp changes in the Vaisala frequency at the scale of the viscous wave the effective vertical viscosity smooths the change in horizontal velocity shear. References: 3 Russian.

UDC 551.463:535.341

Spectral Absorption of Light by 'Yellow Substance' in Ocean Water

[Article by O. V. Kopelevich, S. V. Lyutsarev and V. V. Rodionov, Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] This article gives the results of measurements of light absorption by "yellow substance" with use of a method for its isolation differing substantially from those proposed earlier. The "yellow substance" was isolated from ocean water by sorption with the polyaromatic resin XAD-2 (details are given concerning specific procedures). The collected data confirm the so-called "mixture model," according to which the absorption spectrum of yellow substance represents the envelope of

absorption values of individual chromophores making up the "yellow substance." After comparison with data in the literature it is postulated that there are two fractions of "yellow substance," one of which (evidently low-molecular) determines absorption at less than 500 nm, whereas the other (high-molecular) determines absorption at wavelengths greater than 500 nm. The composition of the first, despite considerable variations, is qualitatively identical in different waters (ocean, sea, river, lake); the composition of the second is different in river and ocean waters. Figure 1; references 16: 9 Russian, 7 Western.

UDC 534.87

Influence of Signal Duration on Correlation Characteristics of Noise Signals Reradiated by Wave-Covered Surface

[Article by A. V. Nosov, Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] In situ measurements of the cross-correlation coefficient of short noise signals reradiated by the wave-covered surface and the initial signals revealed that its value considerably exceeds the theoretical estimate made in the Kirchhoff approximation of signals of infinite duration with large Rayleigh parameters. This was explained earlier by the author on the basis of a model within whose framework the surface is a set of fixed facets, the reflection of the signal from each of which occurs without a change in shape. However, validation of the use of these results required detection of an explicit dependence between the correlation coefficient and signal duration with allowance for the finite velocity of surface movement and a determination of the limits of applicability of its "frozen-in" approximation. Two experiments were carried out. Signals of two types were used. First, signals with a duration up to 4.5 s, which were used in evaluating the autocorrelation coefficient of the total signal and accordingly the cross-correlation coefficient of the initial (direct) signal and the signal reflected from the surface. Second, signals whose duration ensured time separation of the direct and reflected signals, from which their intensity and cross-correlation coefficient were evaluated. The corresponding theoretical and experimental research is described and the limits of applicability of the fixed surface approximation are defined. Figures 4; references 5: 3 Russian, 2 Western.

UDC 551.463.22

Features of Speed-of-Sound Distribution in Mesoscale Test Range in California Current Region

[Article by I. V. Novozhilov, Pacific Ocean Oceanological Institute, Far Eastern Department, USSR Academy of Sciences, Vladivostok]

[Abstract] A hydrological survey of the region adjacent to the southern slope of Henderson seamount was made on the 37th cruise of the "Dmitriy Mendeleyev." An anticyclonic eddy was detected using an "Istok- 4" sounder and standard bathometer. An upper isothermic layer was formed virtually everywhere as a result of wind mixing. This resulted in onset of formation of a near-surface sound channel. A minimal channel thickness (40 m) was observed in the eddy region and a maximal thickness (80 m) on the western periphery. A layer of increased vertical speed of sound gradients was situated at depths 80-200 m. This layer was split in the eddy. The upper part of the velocline, rising closer to the surface, had a cyclonic curvature of the isotachs, whereas the lower part had an anticyclonic curvature. These two parts of the velocline were separated by a layer with a relatively weak vertical gradient in whose upper part there was a closed sound channel. The speed of sound minimum, corresponding to the axis of this channel, was observed in all parts of the test range and seemingly permeated the entire thickness of the waters in a south-easterly direction, passing through the center of the anticyclonic eddy and deepening upon emergence from it. Whereas for the region as a whole the depth of the near-surface sound channel increased from 700 m in the north to 850 m in the south, in the eddy region it attained 1000 m. References: 2 Russian.

UDC 550.837.015.013

Approximate Analytical Solution of Problems in Marine Electrical Prospecting

[Article by V. A. Skornyak, Sevmorgeologiya Geological Production Association, USSR Geology Ministry]

[Abstract] A method is proposed for approximate computation of the potential of a point source situated on the boundary between an upper homogeneous half-space and a lower half-space consisting of media with mutually perpendicular interfaces. The method is based on the idea of substitution of the components of its structures by homogeneous media with known impedances. The impedance is found from a rigorous solution of the problem of potential distribution of a point source in a

three-layer horizontally stratified medium. The solution is found in two steps, which are fully outlined. With appropriate checking for each new class of problems the method can be applied to computation of potential in other complexly structured media, such as in media with mutually perpendicular or slant interfaces containing local inclusions (sphere, prism, etc.). The expressions used in the formulated algorithm are represented in compact form in the form of a series, making possible efficient use of a microcomputer for selecting solutions of the direct problem in electrical prospecting. In this way it is possible to avoid numerical solution of the Laplace equation on a high-speed computer, reduce computation time and the required capacity of the main memory. Figures 4; references: 14 Russian.

UDC 550.837.6

Shore Effect in Magnetotelluric Sounding Method

[Article by A. S. Barashkov and A. G. Yakovlev, Moscow Power Institute; Moscow State University imeni M. V. Lomonosov]

[Abstract] The Tikhonov-Cagniard method is usually used in the interpretation of magnetotelluric sounding (MTS) data, but such a method cannot be used in the case of a nonstratified Earth, such as is the case of coastal zones. Accordingly, the influence of the shore effect on deep magnetotelluric sounding was investigated. A study was made of a two-dimensional model of the Earth with H polarization. The primary field is considered a normally incident plane wave. Emphasis was on determination of the low-frequency asymptotic form of impedance $Z(\omega, x)$ in the so-called H frequency interval. At the studied frequencies impedance is influenced by integral conductivity of the surface layer. This conductivity can be stipulated by a step function. The objective was to compute the impedance $Z(\omega)$ for ω from the H interval as a function of a series of MTS parameters. In addition, a study was made of a model which simulates an island in the ocean. An estimate of the distance at which the shore effect exerts an influence was made. An example of the computations is given. The solutions and simplified equations can be used for testing more complex and precise methods and directly for solution of inverse problems in MTS. Figures 5; references 11: 10 Russian, 1 Western.

UDC 551.465.432

Global Distribution of Rate of Exchange of Heat and Tracers Between Upper Quasihomogeneous and Deep Oceanic Layers

[Article by S. A. Fokin, Leningrad Section, Oceanology Institute]

[Abstract] A qualitatively new method for describing interaction between the upper quasihomogeneous layer (UQL) and deep layer (DL) most fully reflecting the physics of the processes involved was embodied in a nonlinear box model of the thermal regime and carbon cycle in the ocean proposed by B. A. Kagan, et al. (IZV. AN SSSR: FAO, Vol 13, No 4, 1982). However, the geographical variability of exchange in the UQL-DL system is represented in this model by only two boxes and the influence of spatial correlations is excluded. This problem is discussed using the results of computations of heat exchange at the UQL-DL interface obtained within the framework of a two-layer global model of the ocean proposed by B. A. Kagan (DAN, Vol 291, No 3, 1986). In order to describe the exchange of heat and tracers between these layers a pair of variables is introduced applying to the rates of ascending and descending transfer. Formulas are derived for computing the global distribution and seasonal variability of these rates. The results indicate that in the expressions used for describing interaction between the UQL and DL in box models of the ocean it is necessary to take into account terms related to spatial and temporal correlations. Figures 3; references 11: 7 Russian, 4 Western. j

UDC 551.465.16

Transformation and Mixing Processes Accompanying Water Exchange Between Marginal Basin and Ocean (Exemplified by Red Sea Waters)

[Article by V. P. Makashin, S. L. Meshchanov and K. N. Fedorov (deceased), Oceanology Institute, USSR Academy of Sciences]

[Abstract] The temperature and salinity conservation equations for neutral surfaces were used in ascertaining the main physical processes participating in the transformation of Red Sea waters (RSW) in the Gulf of Aden. The presence of three modifications of RSW in the investigated region is closely related to the features of its transformation. Advection plays an important role both in maintaining a quasistationary balance of heat and salt in homogeneous layers of RSW and in the rapid variability of thermohaline structure, related to the motion of lenses. The most intensive transformation, as a result of small-scale turbulent exchange through neutral surfaces, or differential diffusional convection, or their commensurable combination as a function of specific conditions, occurs on the periphery of discrete volumes of RSW. With a relatively small relative contribution of differential diffusional convection to the total divergence of heat flows, caused by negative balance components, its absolute significance, as a result of the great vertical gradients of characteristics, is one-two orders of magnitude greater than at the boundaries of the upper

core of Mediterranean waters in the Atlantic. The movement and transformation of lenses of RSW may stimulate eddy movements in adjacent layers, an effective mixing mechanism. The subsequent propagation of RSW in the Indian Ocean after emergence from the Gulf of Aden is probably accompanied by a decrease in the velocity of their movement and an increase in the relative role of double diffusion effects with a simultaneous decrease in their absolute contribution to the subsequent transformation of RSW. Figures 2; references 17: 5 Russian, 12 Western.

UDC 551.463.8

Generalized Parameters of Microstructure of Marine Hydrosol in Solving Restricted Inverse Light Scattering Problem

[Article by S. L. Oshchepkov and Ye. A. Sorokina, Physics Institute, Belorussian Academy of Sciences]

[Abstract] Problems in solution of inverse multiparameter problems in hydrosol light scattering are examined. This involves choice of the optimal relation between optical information introduced a priori and useful optical information. This not only requires careful choice of the general model representations of the microstructure of suspended matter (fine mineral particles and large biological particles), but also the availability of quantitative data for different model parameters because even an insignificant increase in the number of unknowns results in substantial methodological difficulties. Under such conditions it is highly important to introduce into the problem those generalized parameters of microstructure relative to which the results of interpretation of optical characteristics are stable relative to variations of secondary microstructural factors with are difficult to monitor. Generalized parameters are found which are applicable to the restricted inverse problem of hydrosol light scattering and investigation of methodological errors in their determination under the influence of such factors as the component composition of suspended matter, inhomogeneity of the internal structure and asphericity of particles, each of which are examined in great detail. Figures 3; references 20: 15 Russian, 5 Western.

UDC 551.46.062.7(985)

Methods for Obtaining Ice Cover Data Along Ship Tracks

[Article by A. I. Arikaynen, candidate of geographical sciences, and B. Yu. Levit, candidate of economic sciences, All-Union Scientific Research Institute of Systems Research]

[Abstract] The many difficulties arising when using accumulated information on ice distribution in northern and freezing nonarctic seas are examined for the purpose of simulating transportation conditions along the Northern Sea Route with the objective of lengthening the navigation season. The problems arising in simulating the rates of movement of ships are analyzed in relation to the many substantial gaps in ice information and the nonstandardized methods for its representation. Possible ways for solving the difficulties arising due to the use of different ice cover characteristics and allowance for regional differences are proposed and the requirements on ice observational data are defined. It is stressed that maps of the distribution of ice packing and thickness must be prepared for each type of arctic navigation. In order to represent the entire diversity of navigation conditions the currently used classification of three ice types must be replaced by five categories (very heavy, heavy, average, light, very light). Moreover, in order to simulate fleet operation under extremal conditions it is necessary to have a set of maps illustrating ice distribution and visibility conditions in each arctic sea for the most and least favorable navigation conditions. All such maps must be prepared on a uniform methodological basis for each month from January to December. In actuality, data on ice distribution for November-January are unavailable, another serious problem which must be solved. Figures 2; references: 5 Russian.

UDC 551.465.16

Synoptic and Mesoscale Eddies in North Atlantic Tropical Zone

[Article by V. B. Titov, Southern Division, Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences, Gelendzhik]

[Abstract] A study was made of the dynamics of synoptic and mesoscale eddies in the tropical North Atlantic registered in the course of the POLIGON-70 and MEZOPOLIGON-85 programs. In contrast to synoptic eddies, which follow one another with some overlapping in time, there are usually time intervals between the passage of successive mesoscale eddies. Maps constructed using full series of the filtered low-frequency (synoptic) current component were used in tracing the chronological sequence of movement of synoptic and mesoscale eddies through the measuring system in the test ranges. Stochastic evaluations and the mean values of the periods and amplitudes of current fluctuations responsible for synoptic and mesoscale eddies were obtained. A genetic interrelationship was detected between synoptic and mesoscale eddies, as well as with the meandering of currents in the system of orbital motion of synoptic eddies (this may be a prerequisite for the formation of mesoscale eddies). Figures 4; references: 12 Russian.

UDC 551.463.21

Correlation Between Features of Speed of Sound Profile in Bottom Sediments and Difference Travel-Time Curve in Deep Ocean

[Article by A. V. Orlov, Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences]

[Abstract] A simple method (in a ray approximation) is proposed for evaluating the behavior of the speed of sound profile in bottom sediments on the basis of information obtained in experiments carried out when a ship serves as the sound source and a bottom station serves as the detector. An analysis revealed that the data obtained by the considered method carry very useful information on structure of sediments in the deep ocean primarily due to the registry of rays refracted in sedimentary layers. Conclusions can be drawn concerning the structure of sediments on the basis of the form of the difference travel-time curve. Breaks in the travel-time curve within the determination region are evidence of a nonmonotonic speed of sound profile. Continuous segments of the travel-time curve correspond to a monotonic increase in the speed of sound. Segments with a negative second derivative correspond to layers with a great speed of sound gradient or a reflecting boundary, whereas return segments correspond to layers with a low gradient. A break in the travel-time curve at the boundary of the region of determination does not make it possible to draw any conclusions on the monotonicity or nonmonotonicity of the profile. Intermediate reflecting boundaries result in travel-time curve splitting into branches whose number is equal to the number of reflecting boundaries. The nature of the splitting reflects the behavior of the speed of sound in the neighborhood of the boundary. The intermediate reflecting boundaries make it possible to obtain additional information on the speed of sound profile in sedimentary layers. Figures 2; references 9; 7 Russian, 2 Western.

UDC 551.465.5+551.466

Reflection of Current Inhomogeneities in Ocean Surface State

[Article by V. A. Dulov and V. N. Kudryavtsev, Marine Hydrophysics Institute, Ukrainian Academy of Sciences, Sevastopol]

[Abstract] The influence of inhomogeneities of surface currents on the intensity of wind wave collapse was investigated. Whitecaps on the sea surface are a manifestation of the wind wave dissipation process. Dissipation effects are important for wave components in the dissipation interval k greater than k_D. In this interval, in the absence of currents, such a level of the spectrum is established that its small disturbances lead to strong variations in dissipation rate. With the evolution of waves in the dissipation interval a balance is established in large-scale currents between the energy flux from the current to waves and variations in the dissipation rate. The use of the empirical dependence of the characteristics of wave collapse on wind speed makes it possible to establish a correlation between the characteristics of collapses, the dissipation rate and current gradients. The constructed model of reflection of current gradients in the field of characteristics of collapses is confirmed by in situ data. The model makes it possible to analyze manifestations of characteristic types of oceanic currents at the surface. Such results are necessary for an analysis and interpretation of scanner images of the ocean obtained using passive apparatus operating in the microwave range. Figures 4; references 20: 12 Russian, 8 Western.

UDC 551.465.3

Stochastization of Movement of Packet of Surface Waves in Field of Packet of Internal Waves

[Article by A. A. Slepyshev, Marine Hydrophysics Institute, Sevastopol]

[Abstract] The velocity field of an internal wave at the free surface modulates the field of surface waves. With a closeness of the phase velocity of an internal wave to the group velocity of a narrow- band packet of surface waves the capture of the packet by an internal wave occurs. Relative to a coordinate system moving with the phase velocity of the internal wave, the captured packet performs an oscillating motion in the neighborhood of the resonance of the phase velocity of the internal wave and the group velocity of the packet. In the presence of a packet of internal waves the capture of a packet of surface waves (with at least several harmonics) is possible. It is shown that due to the overlapping of resonances a stochastization of movement of the trapped packet occurs. An adequate condition for stochastization of movement of the packet of surface waves is defined on the basis of this phenomenon of overlapping of the nonlinear resonances. Figures 5; references 11: 8 Russian, 3 Western.

UDC 551.551.466.8

Long Internal Waves in Tropical Atlantic Generated by Periodic Oscillations of Atmospheric Pressure

[Article by V. F. Ivanov, Marine Hydrophysics Institute, Ukrainian Academy of Sciences, Sevastopol]

[Abstract] The relationship between internal waves and atmospheric pressure fluctuations was investigated. Iteration formulas are derived with allowance for stratification, mean velocity and shear stresses, expressed through atmospheric pressure fluctuations, and computations were made of the amplitude characteristics of internal waves generated by semidiurnal and four-day waves of atmospheric pressure propagating in the Atlantic Ocean tropical zone. It is shown that long internal waves with amplitudes of several meters and significant density fluctuations can be generated in this zone whose intensity is dependent to a considerable degree on the direction of propagation of atmospheric pressure waves. For the wave periods and lengths examined in this study the wave velocities in the upper layer and density disturbances in the pycnocline are comparable to the mean velocities and changes in mean density in these layers. Figures 3; references 6; 5 Russian, 1 Western.

UDC 551.468.31

Variability of High-Frequency Part of Sea Wind Waves

[Article by A. Yu. Ivanov, O. Yu. Lavrova and A. D. Rozenberg, Space Research Institute, USSR Academy of Sciences; Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] A better knowledge of the fine spatial-temporal structure of high-frequency and small-scale components of the spectrum of wind waves-ripples is needed for improving noncontact methods for determining sea surface parameters. Accordingly, the temporal variability of the spectral components of sea waves was investigated from a drifting ship in the Pacific Ocean at a time when wind speeds were 1-10 m/s. The mean energy spectra of sea waves were registered using a string wave recorder lowered over the ship's side. The influence of rolling was taken into account using synchronous records of an accelerometer registering the vertical acceleration of the wave recorder suspension point. For frequencies 3-6 Hz (wind speeds 5-8 m/s) there is a poorly expressed variability of ripples synchronous with long waves; in the remaining part of the investigated range the fluctuations have a random character. It is clear that the wind plays a predominant role in forming the fluctuating characteristics of waves in the high-frequency range. Figures 2; references 10: 6 Russian, 4 Western.

UDC 551.465.5

Manifestation of Nonlinearity of Temperature-Salinity-Density Relation in Pacific Ocean Subarctic Frontal Zone

[Article by V. A. Kuzmin, Pacific Ocean Oceanological Institute, Far Eastern Department, USSR Academy of Sciences, Vladivostok]

[Abstract] An analysis was made of values of the $\rho(T, S)$ function on T,S straight lines with different angular coefficients. It is shown that at the point of tangency of the T, S straight lines with the corresponding isopycnal lines ρ has a nominal maximum, whereas the density relation $R\rho = 1$. The possibility of the appearance of a nominal density maximum and compensation of the T and S gradients on oceanic fronts separating the subarctic and subtropical water structures is demonstrated. The subarctic front is a region of generation of the North Pacific Ocean intermediate water mass with a reduced salt content. This water is accompanied by an intermediate layer with an oxygen maximum and is traced immediately after intersection of the front in the direction of the low latitudes. It is possible that the density extremum forming here in winter plays an appreciable role in the mechanism of its formation. The same evidently also applies to the subantarctic front, the region of generation of the Antarctic intermediate water mass, also with a reduced salt content. Figures 2; references 9: 7 Russian, 2 Western.

UDC 551.510.42

Propagation of Atmospheric Pollution Over Surface of Southern Baykal

[Article by V. K. Arguchintsev, A. V. Arguchintseva, V. V. Vlasenko, L. M. Galkin and T. V. Khodzher, Limnology Institute, Siberian Department, USSR Academy of Sciences, Irkutsk]

[Abstract] The limits of horizontal propagation of atmospheric pollutants from industrial plants is particularly easy to trace during winter when the snow cover is an accumulator of dust, soot and other pollutants. This is demonstrated by a snow survey made in March 1987 (details of the methodology are outlined). The method made it possible to compute the accumulation of precipitated matter in the South Baykal area during the year from sources in Irkutsk. Meteorological data on the wind regime were used. Computations were made at the points of intersection of a grid with an interval 5 km which approximated the studied region, making it possible to define the zone of influence of the industrial complex and coastal settlements. The mapped data indicate that most of the dust effluent of enterprises in Irkutsk falls near the sources; the accumulation of solid precipitated matter over the Southern Baykal region from Irkutsk sources does not exceed the natural background. The isolines of concentrations during a calm duplicate the local relief features. Near industrial plants, when calm situations prevail, dangerous pollution can arise which exceeds the maximal possible norms for methyl mercaptan and hydrogen sulfide. The frequency of recurrence of such zones corresponds to the frequency of recurrence of calms during the considered period. The error in determining the accumulation of precipitated matter on the underlying surface does not exceed 20-30%. Figures 5; references: 12 Russian.

)UDC 528.711

Radar Interpretaion of Vegetation in Middle Taiga Region

[Article by A. A. Kotyukh and A. K. Monakhov, Leningrad State University]

[Abstract] A region near Lake Ladoga was investigated using a side- looking radar (SLR) for interpretation of vegetation characteristics. The work was done at different seasons using positive photographs at 1:100 000 obtained with the "Toros" SLR with horizontal polarization. On winter images forests stand out in a mottled pattern. Forests with a dominance of coniferous or hardwood species are difficult to discriminate from one another. Conifers have a dark gray tone, whereas hardwoods have a light gray tone. In winter it is easier to interpret mesorelief than in summer. In winter swamps show up in a light-gray tone. Forest images in spring have an appreciable uniformity of tone. Forests associated with higher relief stand out in a lighter color. Spring images are best for the interpretation of swamps, which stand out in spots of a black tone with clear boundaries. Autumn radar images afford the least possibilities for interpretation because the image is greatly mottled. Even the interpretation of swamps is difficult and the image structure of forests is not well-expressed. The quality of seasonal interpretability of forests by seasons falls in the following sequence: summer-winter-spring-autumn; for swamps—spring-winter- summer-autumn. Such radar images can also be used by geologists for discriminating Quaternary deposits. Medium-scale radar images therefore make it possible to discriminate forests differing in age and quality and sectors with an impaired tree stand (burnovers, cutovers). On radar images of summer flights such sectors show up in a dark tone. On spring radar images overmoistened swamps stand out clearly in a black tone.

UDC 551.593.13:551.524.1+53.082.532

Determining Spectra of Fluctuations of Refractive Index From Observations of Star Occultation by Earth's Atmosphere

[Article by A. S. Gurvich and V. Kan, Atmospheric Physics Institute, USSR Academy of Sciences, Moscow]

[Abstract] In an earlier study (A. S. Gurvich, OPTIKA ATMOSFERY, Vol 2 No 3, pp 237-243) explicit expressions were derived for the two- dimensional spectrum F_i of star scintillations when observed aboard a spacecraft through the Earth's atmosphere. The spatial spectrum was considered stipulated for the random field of relative fluctuations of the refractive index. The possibilities of practical solution of the following inverse problem are now examined: determination of the spectral characteristics of the random field of relative fluctuations of the refractive index from observations of scintillations from aboard a spacecraft. Particular attention is given to the case of highly anisotropic inhomogeneities elongated in two directions, typical for the stratosphere. It is shown that the problem of computing spectra of fluctuations of the atmospheric refractive index on the basis of measurements of scintillations during occultation observations from space can be reduced to the tomography problem on a plane. Ways to determine the vertical one-dimensional spectra of the refractive index are investigated. Examples of computation of the spectra from observations of scintillations aboard the "Salyut-7" orbital station are given. Figure 1; references 12: 11 Russian, 1 Western.

UDC 535.36

Some Features of Resonance Structure of Parameters of Light Scattering by Optically Active Spherical Particles

[Article by T. A. Lopasova and R. F. Rakhimov, Atmospheric Optics Institute, Siberian Department, USSR Academy of Sciences, Tomsk]

[Abstract] The improvement in optical methods for investigating the properties of aerosol dictates the need for an analysis of finer scattering and absorption effects, especially resonance effects. This article gives the results of computations of the effectiveness of extinction and absorption factors corresponding to resonance conditions for electrical and magnetic partial waves within dielectric weakly absorbing spheres as a function of the degree of their optical activity. The influence of the degree of optical activity of particles on light scattering characteristics is investigated. The results of a numerical analysis of the resonance structure of the functional dependence of the extinction and absorption coefficients on the diffractional size of the particles are given. In addition to the regularities inherent for passive particles there are a number of special features for particles of optically active materials. For example, with an increase in the degree of birefringency there is no mutual compensation of diffracted partial waves with left- and right-hand circular polarization due to which the resonance effect is intensified. A distinguishing feature of transformation of the resonance structure of the light scattering coefficients with an increase in the optical activity of the material of the particles is the degeneration of resonances caused by the electrical component of partial waves and an increase in the strength of the resonances in comparison with passive particles for partial waves of the magnetic mode. Figures 3; references 6: 3 Russian, 3 Western.

UDC 531.719.24.08

Simple Method for Determining Correction to Range on Slant Paths

[Article by V. P. Nelyubina and N. F. Nelyubin, Atmospheric Optics Institute, Siberian Department, USSR Academy of Sciences, Tomsk]

[Abstract] The profile of the refractive index must be known along the measurement path for a precise determination of the atmospheric correction ΔS for the measured range. The Δs value is computed by the numerical integration method, which complicates use of precise methods. Accordingly, an effort was made to develop a simple but quite precise method for determining ΔS using a minimum of measurable meteorological data. These conditions are in part satisfied by methods involving use of theoretical models of the atmosphere. In this article use is made of a model of a homogeneous atmosphere which makes it possible to obtain a precise analytical solution of the integrals included in the rigorous formulas. The error in determining ΔS when using the formulas derived in this article was evaluated by its comparison with precise ΔS values (43 profiles of meteorological elements in the range of surface temperatures from -60 to +60°C, surface pressures from 500 to 1100 mb and e_0 values in the wavelength range 0.4-10 μm were used in the comparison). The value of the additional error in determining ΔS when using mean seasonal pressure profiles and the rms error in determining ΔS when using the mentioned formulas are given in tables. References 6: 5 Russian, 1 Western.

UDC 551.46.0:629.78

Correction of Optical Model of Atmosphere in situ for Thermal Sensing From Space

[Article by N. A. Knyazev, Space Research Institute, USSR Academy of Sciences, Moscow]

[Abstract] The presence of information on the vertical temperature profile and on optical state of the atmosphere in spectral measurements of outgoing IR radiation suggested that a physically sound method could be devised for determining the sought-for parameters of the "atmosphere- surface" system directly from satellite measurements in situ. A method is proposed for retrieving optical thickness without use of subsatellite aerological measurements for correcting the optical model of the atmosphere when solving the thermal sensing problem by means of retrieval of the nonselective optical thickness on the basis of measurements of outgoing IR radiation. Examples of solution of model problems are given. Although the article gives this possible approach to solution of the multiaspect problem of spectral-angular thermal sensing of the Earth from space, only regularization of the solutions of the corresponding inverse problems can guarantee reliability in determining the sought-for parameters. Figures 4; references 11: 8 Russian, 3 Western.

UDC 551.510.534

Optimization of Parameters of Ultraviolet Spectrometer-Ozonometer

[Article by A. N. Krasovskiy, A. M. Lyudchik, L. Ch. Neverovich, N. V. Sergeyeva, L. N. Turyshev and A. F.

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Physical Problems imeni A. N. Sevchenko; Belorussian
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[Abstract] The required technical specifications are
given for an instrument ensuring a high accuracy in
determining total ozone content, specifically, a solar
ultraviolet spectrometer-ozonometer meeting these
requirements. The following are discussed: instrument
field of view angle, spectral range, instrument spectral
range, accuracy in setting wavelengths, registry accuracy,
spectral sensitivity, dynamic range and reproducibility
of characteristics. The method for computing total ozone
content on the basis of measurement results is outlined.
The "Pion" surface spectrometer-ozonometer was devel-
oped using mathematical simulation of the measurement
process for optimizing instrument parameters and
reducing the total error in determining total ozone
content to a level not exceeding 1%, reducing overall size
and mass, ensuring stability of its operation under dif-
ferent conditions and automation of measurement pro-
cesses and processing of the results. The instrument is
briefly described (a simple diagram accompanies the
text; a full description will be given in a later publica-
tion). An "Elektronika-60" computer is used for the data
processing unit and for control of all spectrometer-
ozonometer systems. Figure 1; references 14: 9 Russian,
5 Western.

UDC 551.521.14

Database Organization and Management for Determining Optical Parameters of Atmospheric Layers From Measurements of Spectral Radiation Fluxes. I. Formulation of Problem and Results of Computations for Individual Layer

[Article by O. B. Vasilyev and A. V. Vasilyev, Leningrad
State University]

[Abstract] This first part of the research is devoted to an
evaluation of the information yield of vertical profiles of
spectral hemispherical fluxes of short-wave radiation in
the atmosphere for retrieval of the corresponding ver-
tical profiles of optical parameters of the medium with a
breakdown of the inhomogeneous atmosphere into a
number of layers (optical density, probability of survival
of a quantum and elongation of the scattering phase
function) with simultaneous solution of the problem for
all parameters and for all layers. The matrices of partial
derivatives of the mentioned fluxes are examined as a
function of atmospheric optical parameters for cases of
transparent, turbid and highly turbid atmospheres. A
quantitative evaluation of the information yield of mea-
surements is given and the adequate database for solu-
tion of the inverse problem is ensured. Figures 2; refer-
ences: 10 Russian.

UDC 551.521.14

Database Organization and Management for Determining the Optical Parameters of Atmospheric Layers From Measurements of Spectral Radiation Fluxes. II. Evaluation of Information Yield of Measurements in Multilayer Atmosphere

[Article by O. B. Vasilyev and A. V. Vasilyev, Leningrad
State University]

[Abstract] The first part of this research was published in
the same number of the journal (pp 428-433). It gave a
formulation of the problem of retrieval of the optical
parameters of atmospheric layers on the basis of mea-
surements of the vertical profiles of radiation fluxes and
gave an example of convergence of the iteration process
when determining the optical parameters of one layer in
a four-layer atmosphere. This second part examines the
possibility of simultaneous determination of the optical
parameters of all atmospheric layers. A method is
described for linearizing solution of the inverse problem
when processing experimental data on spectral fluxes of
short-wave radiation in the atmosphere for the purpose
of obtaining the vertical profiles of atmospheric optical
parameters: optical thickness, probability of survival of a
quantum and scattering phase function. As an example,
materials are given on determination of the optical
parameters of an individually selected layer of an inho-
mogeneous multilayer atmosphere. The rapid conver-
gence of the solution and the possibility of attaining the
necessary accuracy is demonstrated. [A future, third part
of the research will discuss the determination of atmo-
spheric parameters on the basis of specific experimental
data.] References; 1 Russian.

UDC 681.306

Software Concepts for Solving Atmospheric Optics Problems

[Article by V. B. Novoseltsev and V. T. Kalayda, Atmo-
spheric Optics Institute, Siberian Department, USSR
Academy of Sciences, Tomsk]

[Abstract] There are various aspects of the field of
atmospheric optics which impose rigorous requirements
on the software used in solving pertinent problems. This
article defines concepts applicable to the development
and use of such software which correspond to the
modern level of computer science and which take into
account experience in developing specialized systems for
solution of problems in atmospheric optics. Particular
attention is given to the problem solving support system.

The subject is examined from the point of view of both the programmer-developer and the user. Requirements of both a general and a special character are considered. The architecture of the problem solving support system is discussed in detail. Figures 4; references 15: 14 Russian, 1 Western.

UDC 551.526

Microwave-Radiative Properties of Different Types of Underlying Surface at Negative Temperatures

[Article by K. Ya. Kondratyev, academician, V. V. Melentyev and V. Yu. Aleksandrov, Limnology Institute, USSR Academy of Sciences; Arctic and Antarctic Scientific Research Institute, Leningrad]

[Abstract] A real possibility of developing methods for microwave research on fresh-water ice and permafrost appeared after development of the highly sensitive spectrally polarized "Omega" complex operating in the decimeter range. This article gives the results of computations of the characteristic emission of fresh-water ice and frozen ground under different sounding conditions at different wavelengths, sighting angles and types of polarization and with different states of the investigated surfaces. A three-layer model (air-ice-water, air-snow-frozen ground) was used. Computations were made at the following wavelengths: 0.8, 2, 5, 11, 18, 30 and 60 cm; ice thickness varied from 0 to 140 cm; sighting angles varied from 0 to 60°. It is feasible to use a two-wavelength method for retrieving the thickness of fresh-water ice: the recommended wavelengths are 18.0 and 0.8; 18.0 and 2.0 cm. The two-wavelength method makes possible reliable identification of the age characteristics of lake and river ice in the entire range of change in its thickness. An example of computations of the emission coefficients of a three-layer system is given. Figures 3; references 9: 6 Russian, 3 Western.

UDC 551.501.8:551.521.3

Structural Dynamics of Scattered Signal and Its Relationship to Meteorological Conditions

[Article by Yu. A. Polkanov, Applied Physical Problems Scientific Research Institute, Belorussian State University]

[Abstract] This article continues earlier work by the author on the relationship between the nature of a scattered signal and a number of atmospheric meteorological parameters under conditions of relative thermodynamic stability of its near-surface layer (IZV. AN SSSR: FAO, Vol 21, No 7, 1985). The objective of the research was a study of the dynamics of the structure of inhomogeneities on the basis of data for five series of measurements made at different times in different meteorological situations and a search for the dependence of change in the nature of the structure of inhomogeneities on the character of the meteorological situation. The structural characteristics of scattering signal inhomogeneities are identified with atmospheric inhomogeneities. After special processing it is possible to discriminate two structural components: short- and long-wave. It is shown that there is a different nature of change in the short- and long-wave structural components as a function of the nature of cloud cover and a near-surface temperature inversion. Figure 1; references: 8 Russian.

UDC 551.521.3

Radiation Extinction by Aerosol and Gases in Range 0.23-0.70 m in Atmospheric Surface Layer

[Article by S. M. Pirogov, Atmospheric Physics Institute, USSR Academy of Sciences]

[Abstract] A study was made of the contribution of O_3 and O_2 absorption to total extinction ε_{tot} in the atmospheric surface layer in the spectral range 0.23-0.30 μm. The O_3 and O_2 components are separated in two stages: determination of the O_3 absorption coefficients during ozone variations and determination of the spectral variation of the slightly changing values of the O_2 absorption coefficients. The ε_{mol} coefficients in the UV and visible spectral ranges are known very accurately. It was taken into account that in the range 0.27-0.30 μm absorption due to O_2 is virtually equal to zero and absorption by ozone at 0.274 μm is equal to half the maximal value. The calculated $\varepsilon O_2(\gamma)$ values are in satisfactory agreement with the results obtained by other authors. The aerosol extinction spectra are given for two essentially different states of atmospheric haze obtained with allowance for the contribution of ozone and oxygen to total extinction. Figures 2; references 14: 8 Russian, 6 Western.

UDC 551.521.3

Research on Optical Cross Sections and Scattering Matrices of Horizontally and Randomly Oriented 'Soft' Particles

[Article by V. N. Lopatin and L. Ye. Paramonov, Biophysics Institute, Siberian Department, USSR Academy of Sciences]

[Abstract] The orientation of suspended particles with the long axes in the horizontal plane is possible in the ocean or atmosphere under the influence of gravity or an electrical field, but the orientation of such particles is often random. A light-scattering matrix method for systems of "soft" particles arbitrarily oriented in a plane is analyzed for the case of normal incidence of sounding radiation with emphasis on determination of the oriented structure of suspended matter using information on the transformation (reflection) matrix and applying rigorous light-scattering theory. Numerical computations were made for monodisperse suspensions of elongated spheroidal particles randomly oriented in a plane. The dependence of the effect of extremal clearing of a system of randomly oriented equivolume spheroids on the degree of their asphericity is investigated. Figures 5; references 14: 8 Russian, 6 Western.

UDC 551.521.31

Computation of Short-Wave Radiation Fluxes at Underlying Surface Based on Remote Measurement Data

[Article by Ye. V. Bulychev, A. V. Konovalov and I. V. Mishin, All- Union Scientific and Technical Information Center]

[Abstract] A study was made to derive precise relations making it possible to compute the flux of descending short-wave radiation at the underlying surface using the known flux of ascending radiation at the upper boundary of the atmosphere. The sought-for relations were obtained using the theory of boundary value problems for the transfer of optical radiation in a plane-parallel scattering layer. The problem is examined on the assumption of a horizontal uniformity of the optical properties of the atmosphere and the underlying surface, as a point of departure using known expressions for the brightnesses of outgoing and incident radiation. The derived relations make it possible to compute the fluxes of incident radiation from the known fluxes of outgoing radiation. The operators needed for this purpose are not dependent on the mean albedo of the underlying surface and therefore when using satellite measurements of the ascending flux it is not necessary to have albedo data. Solution of this problem makes it possible to proceed to a model of a horizontally inhomogeneous atmosphere and an underlying surface with nonuniform albedo. It is shown that the results can be used in computing the short-wave component of the radiation balance. Figure 1; references: 6 Russian.

UDC 528.813

Optimal Filtering of Aerosol Scattering Profiles in Laser Sensing in IR Range From Space

[Article by G. N. Glazov, G. M. Igonin and D. M. Leshchinskiy, Atmospheric Optics Institute, Siberian Department, USSR Academy of Sciences, Tomsk]

[Abstract] In the IR range, in contrast to the visible range, there have been only a few local measurements of β_a (aerosol backscattering coefficient). It would be of particular importance to have global measurements of the tropospheric β_a field in both the visible and IR ranges (using orbital lidars). The practical realization of orbital aerosol sensing in the IR range would be simplified if provision is made for a spacecraft to carry a powerful coherent-Doppler lidar based on a CO_2 laser for global measurement of the wind speed profile. In such a case it would be necessary to install an additional processing unit whose results would be used in an optimal interpretation of velocimetric data. Simultaneous measurement of the velocity field and β_a would make possible a global description of transport and diffusion of aerosol pollutants. The $\beta_a(r, t)$ field is stochastic in both time and space. The optimization of processing of lidar signals during the sensing of such objects is possible using optimal Markov filtering. This article explains the basis for such processing, with automatic evaluation of its effectiveness. Computer modeling is used in determining the possibilities of sensing of mesoscale vertical inhomogeneities of β_a from space. The required filtering equations are derived and the accuracy of the procedure is evaluated. Figures 4; references 16: 7 Russian, 9 Western.

UDC 551.551.5

Experimental Research on Coherent Structure Turbulent Currents in Lower Troposphere

[Article by N. Z. Pinus, professor, and G. N. Shur, candidate of physical and mathematical sciences, Central Aerological Observatory]

[Abstract] Turbulent currents in the lower troposphere have a dual structure, consisting of random and stochastic movements, and at the same time are characterized by a combination of moving organized and interacting eddy movements. A study was made of this dual structure for detecting correlated structures at wave numbers k greater than 5×10^{-3}. An aircraft was used in synchronous measurements of the vertical (w') and horizontal (u') wind speed fluctuations at altitudes 300-3000 m and coherent structures were detected in the turbulent

currents by an analysis of the spectra of coherence between u' and w' in the wavelength range 1.5 x 10^{-2}-3.3 x 10^{-4} m^{-1}. The structural features of the spectra are examined, as well as their variability within a turbulent current and from current to current. The individual character of the coherent structure of each turbulent current is emphasized. Figures 2; references 12: 9 Russian, 3 Western.

UDC 551.510:551.553.21(267)

Vertical Structure of Atmosphere During Different Phases of Indian Summer Monsoon

[Article by L. I. Alekseyeva and Ye. K. Semenov, candidates of geographical sciences, and M. A. Petrosyants, professor, Moscow State University]

[Abstract] Radiosonde data registered on 28 Soviet marine expeditions operating in the Indian Ocean during the period 1967-1983 were generalized in an effort to clarify summer monsoon circulation. It was found that during the period of contrasting phases of the summer Indian monsoon there are substantial differences in the structure of zonal and meridional flows in the entire thickness of the troposphere over the Indian Ocean. The greatest changes occur in the northern hemisphere and for the most part affect the western regions of the ocean. The following factors are of fundamental importance for clarifying the physical mechanism of formation of opposite monsoon phases: 1) shifting of the Tibetan anticyclone during periods of breaks to the southeast of its mean position, causing a considerable weakening of the easterly upper tropospheric jet stream; 2) appearance of anomalous southerly winds in the upper troposphere over India and 3) presence of northerly winds over the Indian subcontinent in the lower troposphere, indicating a replacement of moist equatorial air by continental air masses during a period of disruptions of summer monsoonal circulation. Figure 1; references 3 Russian.

UDC 551.501.7:551.507.35:507.7

Comparison of Aircraft Data on Wind and Temperature With Results of Measurements Made on High Meteorological Mast

[Article by A. V. Litinetskiy, N. F. Mazurin and G. N. Shur, candidates of physical and mathematical sciences, and N. P. Topanchuk, Central Aerological Observatory; Tayfun Scientific Production Association]

[Abstract] The results of synchronous same-level measurements of meteorological parameters obtained using an instrument array carried aboard an aircraft and another mounted on a high meteorological mast are given. Simultaneous measurements were made at Obninsk on 23 and 28 July 1987 at a height 300 m. In addition to giving averaged temperature, wind speed and direction values, data are given on the spectral densities of the vertical and horizontal components of turbulent wind speed fluctuations. The measurement instruments and the details of the method for carrying out the experiment are described. Tables 1 and 2 give the technical specifications for mast and aircraft instruments and Table 3 gives a comparison of mast and aircraft measurements. The intercomparison of temperature, wind speed and direction data and values of the vertical and horizontal components revealed that the two sets of data are in excellent agreement. Figure 1; references: 5 Russian.

UDC 528.711

Comparative Analysis of Radar Images and Aerial Photographs of Arid and Mountainous Landscapes

[Article by A. A. Kotyukh and A. K. Monakhov]

[Abstract] A comparison of the information yield of radar images and aerial photographs was made relative to the interpretation of different natural and anthropogenic features in arid zones. Radar images were obtained in May at 1:100 000 using a side-looking radar operating at 3.2 cm; the aerial photographs, at 1:85 000-1:100 000, were obtained in July-September. The comparison revealed that when interpreting elements of mountainous relief radar images are more graphic than aerial photographs. In the interpretation of forests there may be significant discrepancies between the two types of survey materials, with aerial photographs usually being favored. In the interpretation of woody-scrub vegetation in the desert the two alternatives are equally acceptable. On aerial photographs reedy overgrowths occupy only half the area indicated by radar images (because the photos were taken in autumn when the reeds were partially dessicated and knocked down), but dense reedy overgrowths can always be interpreted reliably on aerial photographs. It is emphasized that interpretation of terrain features from radar images is possible only when using materials for two mutually perpendicular flight lines. Although aerial photographs in general have a greater information yield, in some cases radar images are only somewhat inferior or are superior. The information yield and reliability of radar images will constantly increase with a shortening of the wavelength for side-loking radars and with a changeover to millimeter waves. Arid region radar images should be used in combination with aerial photographs, in particular, in geological interpretation of mountainous regions and in various kinds of regionalization, as well as in land use surveys. References: 4 Russian.

Cruises of Scientific Research Ships (July-December 1988)

18650199 Moscow ZEMLYA I VSELENNAYA in Russian No 3, May-Jun 89 pp 79-81

[Unsigned article]

[Text] Following is a listing of cruises of scientific research ships carried out by the Soviet Union during the period July-December 1988.

1. Ship: "Akademik Mstislav Keldysh" (Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences); region: Eastern Atlantic, Tyrrhenian Sea; objective of expedition: Marine geology: study of seamounts and also tectonically active regions; notes: scientists of Great Britain, United States, Italy, West Germany and Finland also participated in the expedition.

2. Ship: "Rift" (Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences); region: Azores-Gibraltar region of Atlantic Ocean; objective of expedition: Marine geology: research on structure and deformation of oceanic crust.

3. Ship: "Vityaz" (Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences); region: Eastern Atlantic; objective of expedition: Hydrophysics: study of intrathermocline eddies of Mediterranean origin; notes: specialists from Cuba and Morocco participated.

4. Ship: "Gidrobiolog" (Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences); region: western part of Black Sea; objective of expedition: Marine Chemistry: study of chemical exchange at water-bottom interface in shelf zone; notes: work done in collaboration with Bulgarian scientists.

5. Ship: "Akademik Kurchatov" (Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences); region: Atlantic Ocean, Mediterranean and Black Seas; objective of expedition: Hydrophysics: study of laser radiation in water layer, optical characteristics of waters in relation to hydrodynamic processes.

6. Ship: "Shelf" (Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences); region: northern part of Baltic Sea; objective of expedition: Marine geology: study of sedimentation processes, lithology and geological structure of sedimentary layer; notes: a Finnish scientist participated in the expedition.

7. Ship: "Professor Shtokman" (Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences); region: North Atlantic and Barents Sea; objective of expedition: Hydrophysics: study of inhomogeneities of sedimentary layers by acoustic and seismic methods, sound propagation, acoustic noise in ocean; notes: most of work carried out jointly with "Akademik Sergey Vavilov."

8. Ship: "Dmitriyev Mendeleyev" (Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences); region: northern part of Pacific Ocean and Bering Sea; objective of expedition: Marine geology: seismostratigraphic study of sedimentary layer, structure and composition of oceanic lithosphere; notes: an American specialist worked with the expedition.

9. Ship: "Akademik Sergey Vavilov" (Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences); region: North Atlantic and Barents Sea; objective of expedition: Hydrophysics: study of acoustic signals and acoustic noise. Research was carried out for the first time on internal waves by acoustic apparatus and acoustic measurements were made for the first time using a buoy with controllable buoyancy with a multielement antenna; notes: Finnish specialists participated in cruise.

10. Ship: "Akademik Aleksandr Vinogradov" (Far Eastern Department, USSR Academy of Sciences); region: northwestern part of Pacific Ocean and Philippine sea; objective of expedition: Hydrophysics: study of sound propagation along extended paths, influence of mesoscale inhomogeneities and frontal zones on sound propagation in sea water, sound scattering and absorption; notes: multisided geological-geophysical and geochemical research was carried out en route in the central part of the Pacific Ocean.

11. Ship: "Akademik Aleksandr Nesmeyanov" (Far Eastern Department, USSR Academy of Sciences); region: northwestern part of Pacific Ocean; objective of expedition: Marine geology: gravimetric observations, study of thickness of sedimentary mantle, mineralogical composition and products of volcanism of seamounts in Emperor Range; geothermal observations and tests of new bottom seismic stations.

12. Ship: "Akademik M. A. Lavrentyev" (Far Eastern Department, USSR Academy of Sciences); region: northwestern part of Pacific Ocean; objective of expedition: Hydrophysics: research on sound propagation, hydrological parameters, ocean noise, internal waves and electromagnetic field.

13. Ship: "Akademik Oparin" (Far Eastern Department, USSR Academy of Sciences); region: southwestern part of Pacific Ocean and Sea of Okhotsk; objective of expedition: Marine biology: study of marine invertebrates and microorganisms as source of physiologically active compounds.

14. Ship: "Professor Bogorov" (Far Eastern Department, USSR Academy of Sciences); region: Crater Bay (Pacific Ocean); objective of expedition: Marine biology: study of aqueous ecosystem in zones of influence of underwater gas and hydrothermal activity.

15. Ship: "Professor Gagarinskiy" (Far Eastern Department, USSR Academy of Sciences); region: northwestern part of Pacific Ocean and Sea of Okhotsk; objective of expedition: Marine gelogy: detailed study of structure of lithosphere of East Asian active margin in neighborhood

of Kurile Islands; research on seismicity of Kurile-Kamchatka region and composition of bottom waters. Thirty-six underwater earthquakes registered.

16. Ship: "Vulkanolog" (Far Eastern Department, USSR Academy of Sciences); region: northwestern part of Pacific Ocean; objective of expedition: Marine geology: study of influence of volcanogenic- sedimentary section of morphology of underwater volcanoes of Kurile and Aleutian arcs, bottom relief and structure of sedimentary mantle on shelf of Avachinskiy Gulf.

17. Ship: "Morskoy Geofizik" (Far Eastern Department, USSR Academy of Sciences); region: northwestern part of Pacific Ocean; objective of expedition: Marine geology: gravimetric observations, study of thickness of sedimentary mantle between Shatskiy Range and Emperor Range.

18. Ship: "Akademik Vernadskiy" (Marine Hydrophysics Institute, Ukrainian Academy of Sciences); region: western part of tropical Atlantic; objective of expedition: Hydrophysics and hydrochemistry: remote determination of hydrometeorological parameters of oceanic surface layer; research on turbulence of hydrophysical fields; study of thermocline lens of Mediterranean waters in Atlantic Ocean in neighborhood of Portugal.

19. Ship: "Mikhail Lomonosov" (Marine Hydrophysics Institute, Ukrainian Academy of Sciences); region: eastern part of tropical Atlantic; objective of expedition: Hydrophysics: study of large-scale oceanic circulation, anomalies of hydrophysical fields and frontal formations.

20. Ship: "Professor Kolesnikov" (Marine Hydrophysics Institute, Ukrainian Academy of Sciences; region: Black and Mediterranean Seas; objective of expedition: Hydrophysics: experimental study of three- dimensional hydrological structure of upper layer of sea during summer. Maps of water temperature, salinity, transparency, current velocity and vorticity zones were plotted.

21. Ship: "Professor Vodyanitskiy" (Institute of Biology of Southern Seas, Ukrainian Academy of Sciences); region: Black and Aegean Seas; objective of expedition: Marine biology: study of present-day ecological conditions for exchange of species through Bosporus and evaluation of hydrochemical regime of Black and Aegean Seas.

22. Ship: "Akademik Kovalevskiy" (Institute of Biology of Southern Seas, Ukrainian Academy of Sciences); region: Black and Aegean Seas; objectives of expedition: Marine biology: study of Black Sea sprat and other mass species of fish in different sectors of range; determination of radioactive pollution of water, bottom deposits, influence of runoff of Dnepr, Dnestr and Danube on distribution of radioactive substances in western part of Black Sea.

23. Ship: "Zarya" (Leningrad Section, Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, USSR Academy of Sciences); region: Baltic Sea; objective of experiment: repeated component geomagnetic measurements at four marine secular variation stations; notes: Finnish and Swedish specialists participated in expedition.

24. Ship: "Yevpatoriya" (Computation Center, Siberian Department, USSR Academy of Sciences); region: Black Sea; objective of expedition: Marine geophysics: tests of new geophysical apparatus; clarification of possibility of detecting concentrations of gas hydrates; notes: ship made its last voyage.

25. Ship: "Dalniye Zelentsy" (Murmansk Marine Biological Institute); region: Barents Sea; objective of expedition: Marine biology: study of distribution of mass species of bottom fish and invertebrates; collection of samples of benthos and data on feeding of fish in fishing region.

26. Ship: "Akademik Boris Petrov" (Institute of Geochemistry and Analytical Chemistry imeni V. I. Vernadskiy, USSR Academy of Sciences; region: Sea of Japan; objective of expedition: Marine chemistry: study of propagation of artificially injected admixture in ocean waters; study of spatial-temporal variations of individual isotopic components of gamma field of sea water and near-water atmospheric layer; research on relationship between radioactivity field and other hydrophysical fields.

27. Ship: "Akademik Nikolay Strakhov" (Geology Institute, USSR Academy of Sciences; region: equatorial Atlantic; objective of expedition: Marine geology: collection of geological-geophysical data in equatorial block of Mid-Atlantic Ridge. A multiaspect geophysical survey was made with a multiray echo sounder; notes: specialists from Great Britain, Brazil and the United States participated in the cruise.

28. Ship: "Arnold Veymer" (Thermoelectrophysics Institute, Estonian Academy of Sciences); region; Baltic Sea; objective of expedition: Hydrophysics and biochemistry: study of sea water salinity, study of hydrophysical processes and their influence on hydrobiological and hydrochemical fields, research on ecological state of ocean; notes: a study of inertial waves in the Arkona Basin was made together with the "Professor A. Penck" scientific research ship (GDR).

Mechanisms of Variations of Total Content of Impurities Under Influence of Internal Gravity Waves

[Article by A. N. Gruzdev, Atmospheric Physics Institute, USSR Academy of Sciences]

[Abstract] Two mechanisms of variations in the total content of atmospheric impurities in internal gravity waves are examined: deformation of the impurity layer due to vertical movements and photochemical processes. Evidence is presented that the first mechanism is more important. The most favorable conditions for the experimental detection of variations are given. A method for observing stratospheric internal gravity waves based on measurement of wave variations of the total content of impurities is outlined. It is shown that the most important of the mechanisms of variations in total concentrations of impurities in internal gravity waves is the dynamic deformation of the layer of impurity caused by divergence of the horizontal velocity of internal gravity waves. The relative role of photochemistry in variations of the total concentration of impurities is small, at least for internal gravity waves with periods of about 30 minutes. A great increase in variations of the total concentration of impurities, favoring their experimental detection, can be expected in measurements along a slant direction oriented opposite the horizontal phase velocity c_h when c_v is greater than O and along c_h when c_v is less than O. Figures 3; references 22: 9 Russian, 13 Western.

Variability of Atmospheric Transparency Under Influence of Transport of Sahara Aerosol Into Atlantic Ocean Tropical Zone

[Article by P. P. Anikin, Ye. N. Leontyeva, I. N. Plakhina and A. Kh. Shukurov, Atmospheric Physics Institute, USSR Academy of Sciences]

[Abstract] Experimental values of integral atmospheric transparency over the Atlantic Ocean region to which air masses transport aerosol of desert origin from the African continent are presented. The factors responsible for the variability of integral transparency are analyzed. The contribution of aerosol to attenuation of the flux of direct solar radiation is estimated and it is shown that aerosol is the principal component determining atmospheric optical thickness and the degree of its variability. Integral atmospheric transparency in the observation region is characterized by both a decrease in the mean value and a higher variability in comparison with the mean climatic values. The aerosol contribution to total atmospheric optical thickness τ averages about 70%, whereas τ variability is entirely determined by the variability of its aerosol component. The single scattering albedo values indicate the presence of insignificant absorption in marine aerosol. Strong transport of continental aerosol over the ocean appreciably decreases the total flux reaching the surface. A change in transparency from 0.70 to 0.44 decreases the mean Q (total solar radiation) value by 30 W/m². Figure 1; references 14: 13 Russian, 1 Western.

Influence of Cirrus Clouds on Solar Radiation Fluxes

[Article by A. G. Petrushin and T. A. Tarasova, Atmospheric Physics Institute, USSR Academy of Sciences]

[Abstract] Although cirrus clouds exert a strong influence on the radiation balance of the climatic system, they are the least studied cloud genus. Accordingly, experimental data from study of the radiative properties of cirrus clouds were used in computing the integral fluxes of solar radiation for different models of cloud microstructure and composition of the atmosphere outside the clouds. These data were compared with actinometric measurements. A change in solar radiation transmitted and reflected by the cloud layer was found as a function of its optical characteristics, computed for models of hexagonal prisms (previous research was centered on spherical particles and monodisperse cylinders). The extinction factor, mean cosine of elongation of the scattering function and single scattering albedo were computed for large hexagonal ice prisms with a random spatial orientation. These data facilitate measurements and computations of both the optical characteristics and the radiation fluxes in Ci clouds. Figures 4; references 15: 6 Russian, 9 Western.

Correlation Between Optical Thickness and Air Humidity Over Ocean

[Article by A. V. Smirnov and K. S. Shifrin, Leningrad Hydrometeorological Institute; Oceanology Institute, USSR Academy of Sciences]

[Abstract] A study was made of the correlation and anticorrelation between simultaneous values of aerosol optical thickness of the marine atmosphere τ and relative air humidity f. In "dry" and "moist" samples there is an anticorrelation and correlation respectively between these parameters. This is attributable to the fact that an increase in turbulent exchange results in a decrease in f and an increase in τ due to an increase in transport of droplets formed by the sea surface into the atmosphere. This anticorrelation is observed in a "dry" sample in which the near-water layer extinction coefficient is almost not dependent on humidity, which is not the case for a "moist" sample in which a rapid increase in the extinction factor with an increase in f overtakes the anticorrelation associated with turbulent exchange.

There is a positive correlation between the Angstrom parameter α and τ_0; in interpreting the correlation between α and f it is important to take into account the general nature of the dependence of α on τ_0. Figures 6; references 6: 5 Russian, 1 Western.

UDC 551.543

Experimental Determination of Exponent of High-Frequency Part of Spectrum of Atmospheric Pressure Fluctuations

[Article by N. F. Gorshkov and Ye. B. Moskvina, Moscow State University]

[Abstract] The study of atmospheric pressure fluctuations in the surface layer has definite advantages in research on turbulent movement because this satisfies conditions facilitating study of turbulent flow (uniformity of movement and high Reynolds numbers). The spectrum of fluctuations of atmospheric pressure was therefore investigated, for the most part in the steppe (height of grass cover 0.1-0.2 m), but in drawing conclusions allowance was made for the results of measurements over the wave-covered sea surface and under forest conditions. It was possible to define the high-frequency part of the spectrum by a comparison of spectra measured under different conditions for different vegetation cover heights and different wave heights. The results obtained by N. F. Gorshkov (VESTN. MGU. SER. FIZIKA, ASTRONOMIYA, Vol 26, No 4, pp 87-92, 1985 and A. I. Grachev, et al. (IZV. AN SSSR: FAO, Vol 24, No 2, pp 221-223, 1988), together with the results given in this study, indicate the possibility of approximation of the spectrum of atmospheric pressure fluctuations by a power function, not with a single exponent, but with several exponents, depending on thermal stratification or the parameter of instability of movement. The estimated values of this parameter are tabulated. Figures 3; references 13: 8 Russian, 5 Western.

UDC 551.554

Influence of Unstable Stratification on Wind Speed and Temperature Profiles in Surface Layer

[Article by B. A. Kader and V. G. Perepelkin, Atmospheric Physics Institute, USSR Academy of Sciences]

[Abstract] Wind speed and temperature profiles are still described within the framework of a two-layer model, although many years of experimental research have revealed that theoretical predictions are not fully consistent with experimental data, putting in doubt the very existence of a region of free convection in the boundary layer. In order to clarify this matter, this article gives experimental data obtained in the even, uniform Tsimlyansk steppe test range in 1981-1986 and data obtained within the framework of a three-layer model for theoretical prediction (outlined in detail by B. A. Kader, IZV. AN SSSR: FAO, Vol 24, No 12, pp 1235-1250, 1988). These data confirm the existence of a sublayer of free convection and a dynamic-convective sublayer in the unstably stratified atmospheric surface layer. The material obtained on foreign expeditions and in the Tsimlyansk test range confirm the character of the wind speed and temperature profiles in an unstably stratified atmospheric surface layer predicted by the three-layer model. Figures 5; references 21: 12 Russian, 9 Western.

UDC 551.463.5

Influence of Optical Anisotropy of Medium on Polarization Characteristics of Backscattered Signal in Pulsed Sensing of Ocean

[Article by A. P. Vasilkov, T. V. Kondranin and Ye. V. Myasnikov, Oceanology Institute, USSR Academy of Sciences; Moscow Physical Technical Institute]

[Abstract] Within the framework of an isotropic medium it is difficult to explain the experimentally discovered ellipticity of the light field in the sea. This may be attributable to gyrotropy of the medium or a predominant orientation of the particles. This article gives a detailed examination of the influence of the first factor on the polarization characteristics of a backscattered signal in an absorbing gyrotropic medium with strongly anisotropic scattering irradiated by a pulsed narrow restricted beam. Expressions for the polarization characteristics of the backscattered signal are derived in a small-angle approximation. These serve as a basis for an analysis of the nature of polarization of a reflected signal with both isotropic and gyrotropic scattering. The appearance of the fourth Stokes parameter in the structure of the backscattered signal in the case of an unpolarized or plane polarized section is evidence that the medium is gyrotropic. The same effect may appear when there is a predominant orientation of the particles. Rotation of the backscattered signal polarization ellipse can be caused only by the presence of a predominant orientation of the scattering particles. As in the case of an isotropic medium, with sufficiently large receiver angles the polarization characteristics of the reflected signal are slightly dependent on the receiver angle, indicatrix characteristics and absorption index. Figures 2; references 18: 13 Russian, 5 Western.

UDC 551.501.776:551.508.856:551.507.352

Determination of Altitude of Cloud Cover Upper Boundary by Airborne Lidars

[Article by L. N. Birich and A. Ye. Tyabotov, candidates of physical and mathematical sciences, Central Aerological Observatory]

[Abstract] The use of lidars is highly promising for determining the altitude of the upper cloud boundary (UCB) at a virtually real time scale, replacing the current, highly subjective method (visual observations from aboard an aircraft). The accuracy of the lidar method for determining UCB altitude is dependent on instrumental and methodological errors and the form of the upper surface of the sounded cloud cover. The random component of the total methodological and instrumental error is equal to about 30 m. The error in determining the altitude of the UCB of clouds with an even upper surface is about 50 m, whereas for those with an uneven boundary it falls in the range 90-170 m. Before introducing the lidar method on a routine basis it is necessary to estimate the savings which would be realized by its introduction, a working copy of an automatic airborne lidar must be constructed, methods and instruments for its metrological support must be developed, synchronous measurements must be made for determining UCB altitude by lidar and visually by the aircraft aerologist and the statistical correlations between the data obtained by these two methods must be investigated. There is every evidence that these problems can be solved. Figure 1; references: 6 Russian.

UDC 551.465.739.2

Rate of Ocean-Atmosphere Gas Transfer in North Atlantic Determined From Microwave Radiometry Data From 'Cosmos-1602' Artificial Earth Satellite

[Article by V. B. Lapshin, I. G. Ragulin, A. I. Simonov and V. S. Suyetin, State Oceanographic Institute, Moscow; Marine Hydrophysics Institute, Ukrainian Academy of Sciences, Sevastopol]

[Abstract] Microwave measurements of the ocean were made along satellite passes over the North Atlantic by the "Cosmos-1602" artificial earth satellite to ascertain the ocean-atmosphere gas transfer rate. The spatial resolution of the radiometer in the channel 8.5 cm was 85 km. Radiobrightness temperature was averaged for one-degree trajectory segments. Maps were constructed for 23-24 February 1985 (synoptic charts of radiobrightness temperature and gas transfer rate). The zones of maximal rate of gas exchange are associated with regions of maximal wind speeds and maximal dispersals, whereas in regions of a light wind and small dispersals the rates of gas exchange are minimal. An analysis and comparison of the maps with clarification of the factors exerting a significant influence on the rate of gas exchange between the ocean and atmosphere was given in full by these authors in an article with the same name deposited at the All-Union Institute of Scientific and Technical Information (6 February 1989, No 750-V89), which also discusses the merits and shortcomings of the proposed method and gives a lengthy bibliography. Figure 1; references 3: 1 Russian, 2 Western.

UDC 528.813

Retrieval of Atmospheric Optical Thickness Using Space Thermal Sensing Data

[Article by N. A. Knyazev and V. V. Badayev, Space Research Institute, USSR Academy of Sciences, Moscow]

[Abstract] A method is proposed for retrieving the vertical profile of atmospheric optical thickness on the basis of angular measurements of outgoing radiation. A search for a solution is made with a minimizing of the nonclosure in a set of monotonic and bounded functions. Examples of solution of model problems are given. In particular, the results of retrieval of atmospheric optical thickness are given on the basis of data from the fifth channel ("transparency window") of the IR radiometer carried aboard the Cosmos-1151 satellite. Cloudy and cloudless conditions are examined and pertinent procedures for the two situations are outlined. The proposed method can be used in correcting the atmospheric transfer operator for use in the interpretation of satellite measurements in the IR spectral range. Figures 6; references 18: 15 Russian, 3 Western.

UDC 551.521:629.195

Study of Variability of Distorting Influence of Atmosphere Over Caspian Sea

[Article by Sh. A. Akhmedov and N. A. Agayev, Space Research Scientific-Production Association, Baku]

[Abstract] A study was made of the distorting influence of the atmosphere over the Caspian Sea as a function of wavelength (in the range 400-700 nm), observation angle (0-70°) and solar zenith distance (0-70°). The initial optical parameters were the aerosol thicknesses of the atmosphere obtained from measurements of integral

direct solar radiation at the actinometric station on Artem Island. The results show that in order to ensure a minimal influence of atmospheric radiation factors on spectrophotometric information obtained from space over the Caspian Sea the maximal values of solar zenith distance must not exceed 30°. With an increase in solar zenith distance the transforming and attenuating influence of the entire thickness of the atmosphere considerably increases. With an increase in wavelength the attenuating influence of the atmosphere outside the absorption band decreases, which is attributable to a decrease in the scattering properties of its molecular and aerosol components. The optimal spectral interval for space photometric measurements of the Caspian Sea for which the influence of atmospheric fluctuations is minimal is the wavelength range 600-700 nm. Figures 3; references: 12 Russian.

UDC 629.19:851

Design Aspects of Space Photographic Systems With Maximal Resolution

[Article by V. A. Kiryanov, V. P. Nesterov and G. R. Uspenskiy]

[Abstract] The authors review the necessary parameters and methods for developing an optical system for obtaining a range of images meeting the maximal spatial resolution requirements in the visible and near-IR ranges. The presented materials suggest that the resolution of optical systems should be in the range 1-2 m for solving many important problems in remote sensing. The maximal requirements for environmental problems requiring continuous observations can be satisfied by an optical system with a diameter of the composite main mirror 10-20 m put into a geostationary or geosynchronous orbit. The embodiment of a large optical system with a maximal quality of the registered image can be ensured using means for checking and adaptation of the principal optical system elements. Figures 7; references: 10 Russian.

UDC 528.8.044

Problems in Potential of Space Radars

[Article by M. O. Drabkin and T. G. Kurevleva, State Scientific Research Center for Study of Natural Resources, Moscow]

[Abstract] The use of active radar systems involves a considerable increase in mass, size and consumed power in comparison with passive remote sensing systems, especially at space ranges. Further development of such radars dictates attainment of the necessary energy potential. In this article a new criterion is proposed for evaluating potential. The signal-to-noise ratio used in the past is replaced by the criterion $J(\sigma^0)$, equal to the mean quantity of information in radar data for detecting a sector of the sounded surface with a stipulated specific effective scattering area against the noise background. Expressions are derived for computing and optimizing the parameters of proposed side-looking radars and radars with a synthesized aperture, for choosing the dimensions of their antennas and spacecraft orbital altitude, and also for estimating the criterion values on the basis of the results of flight and laboratory research. The practical applicability of the formulas is illustrated in the example of radars on the Cosmos-1500 and Seasat satellites. The results of an analysis of ways to increase the potential of satellite radars are given. Figures 7; references 12: 4 Russian, 8 Western.

UDC 528.042.8

Synthesis of Geophysical Field Images From Satellite Along-Track Microwave Radiometry

[Article by A. N. Vystavkin, B. G. Kutuza, Yu. V. Obukhov, M. T. Smirnov and Ye. B. Terentyev, Radio Engineering and Electronics Institute, USSR Academy of Sciences, Moscow]

[Abstract] A method is proposed for automated synthesis of images of two-dimensional fields of geophysical parameters on the basis of processing of along-track satellite microwave-radiometric data which make it possible to obtain images of fields with time variability scales of about 3-10 days and with a spatial resolution 200-500 km. The image synthesis system is built around a personal computer with graphic routines. The method also can be used in the processing of panoramic measurements. The proposed algorithms for the correction of experimental data are based on physical assumptions on the possible reasons for distortions and are applied in an irregular spatial digitization grid. This automated synthesis system provides for participation of a radio physicist in the stages of inspecting and rejecting undesired data, choice of data correction parameters and palettes of pseudocolors and finalization of parameter maps. Figures 2; references 11: 9 Russian, 2 Western.

UDC 528.714.2

General Model for Computation and Analysis of Rate of Optical Image Shift in Survey of Earth's Surface

[Article by A. S. Batrakov]

[Abstract] In earlier studies (ISSLED. ZEMLI IZ KOS-MOSA, No 1, pp 79-85, 1984; OPT.-MEKH. PROM-ST, No 8, pp 10-13, 1984) the author gave reviews of publications on methods for determining the rate of shift of an optical image and outlined their limitations. In the latter article a development and generalization of methods for predicting the rate of this shift was proposed which is based on a model in which the motion of a spacecraft relative to the Earth's surface at each moment in time is regarded as translational. Although theoretically this can be regarded as rigorous, in practice it gives rise to a number of significant difficulties in computations and general analysis. The proposed alternative takes into account the configuration of the Earth's surface and the orbital motion of the survey camera in the case of its arbitrary orientation and in the presence of angular velocities in three coordinate axes. Allowance for the specifics of the survey is ensured by use of a rotating coordinate system whose center is referenced to the Earth's center and one of whose axes passes through the survey camera projection center. The computation expressions are reduced to a compact form which requires minimal computation time. Figures 2; references: 7 Russian.

Principal Scales of Spatial Structure of Radiation Fields of Ocean- Atmosphere System Determined From Aerospace Data

[Article by L. G. Istomina and M. S. Malkevich, Space Research Institute, USSR Academy of Sciences, Moscow]

[Abstract] The results of statistical processing of the spatial distribution of reflected solar radiation and characteristic radiation of the ocean-atmosphere and cloud cover are examined on the basis of aerospace measurements. By a comparison of the quantitative estimates a study was made of the direct and inverse relationships among the statistical characteristics of these fields. At least four principal scales of spatial inhomogeneities of the brightness field and characteristic radiation in the cloudy atmosphere were defined which virtually coincided with similar spectra of cloud cover inhomogeneities. The estimates made of the horizontal structure of radiation fields confirmed the soundness of choice of the spatial resolution of the multichannel microwave and IR radiometers carried by the Cosmos-1151 satellite. The coincidence of the main scales of these three empirical fields must be related to common physical factors involved in generation of these fields. Figures 6; references 18: 16 Russian, 2 Western.

Statistical Characteristics of Spectral Structure of Attenuation of IR Radiation by Vertical Column of Atmosphere

[Article by A. I. Chavro and A. Kh. Shukurov, Atmospheric Physics Institute, USSR Academy of Sciences]

[Abstract] The statistical characteristics of the spectral structure of attenuation of IR radiation by a vertical column of the atmosphere, obtained on the basis of a statistical analysis of experimental data from surface measurements of the attenuation of solar radiation in the "transparency windows" in the range 2-13 μm, were determined. Measurements of the spectral transmission of a vertical column of the atmosphere were made during five periods: summer 1970; summer 1971; winter and spring 1972; summer 1972; spring, summer and autumn 1974. Seasonal differences are analyzed. The "long Bouguer method" was used in data processing, making it possible to obtain the optical thicknesses of a vertical column $\tau(\lambda_i)$ with a quite high accuracy. Estimates were obtained for $\tau(\lambda_i)$ in the "windows" for the IR spectral region which indicate a substantial contribution of the aerosol component to the integral optical thickness during summer. Analysis of different correlations indicates that the $R_{\tau\tau}$ values (normalized matrix analogues) between $\lambda = 370$ and the "windows" of the interval 11-12 μm may substantially differ from unity, which makes it difficult to use the three-channel method for determining ocean surface temperature from satellites. Spectral variation of optical thickness $\tau(\lambda_i)$ in the range 2-13 μm with an adequately high accuracy is described by three eigenvectors of the $B_{\tau\tau}(\lambda_i, \lambda_j)$ autocorrelation matrix. References 9: 8 Russian, 1 Western.

Laser Analysis of Total Concentration of Higher Hydrocarbons Against Methane Background

[Article by R. M. Abdullin, V. P. Biryulin, A. I. Popov and A. V. Sadchikhin; Moscow Physical Engineering Institute]

[Abstract] A new method is proposed for determining the sum of higher hydrocarbons against a background of a high methane content. The method is based on use of a strong qualitative difference between the dependencies of the absorption coefficients of radiation of a He-Ne laser in methane and in higher hydrocarbons on pressure of a gaseous medium in the range $0-10^5$ Pa. A diagram of the experimental apparatus accompanies the text (with

10 components identified), serving as a basis for a discussion of its theory and operating principles. Typical records of analyzer readings are given for cases when the analyzed sample contains only methane, a mixture of methane and propane and when there are no hydrocarbons in the sample. The analyzer does not sense methane up to concentrations 5×10^{-2} % by volume. Response to propane was determined by stability of the analyzer zero line. Taking into account the noise observed during registry of the useful signal and that the signal from methane does not exceed this noise for c_M about 5×10^{-2} % by volume, it appears that the described method makes it possible to determine the concentration of higher hydrocarbons in mixtures with methane. For example it was possible to determine 1 ppm of propane when the methane background was greater by a factor of 100. Figures 4; references 10: 6 Russian, 4 Western.

UDC 528.024.4/535.311

Geodetic Refractometry Methods Using Laser Sounding of Atmosphere

v, docent, candidate of technical sciences, Gorkiy Order of the Red Banner of Labor Civil Engineering Institute imeni V. P. Chkalov]

[Abstract] It is proposed that geodetic refractometry problems be solved by using pulsed laser sounding of the atmosphere. The possibilities of known schemes for determining the structural characteristic of the atmospheric refractive index and determining the refraction trajectory are analyzed. Algorithms are proposed for determining the refraction angles from the structural characteristic of the atmospheric refractive index using the constancy of the ratio of angles of refraction in time. Methods for constructing a digital model of the refraction field on the basis of lidar measurements are developed and described. The results of processing of experimental data confirming the correctness of these methods are given. Figures 4; references: 12 Russian.

UDC 528.711.1(202):550.462

Estimation of Atmospheric Influence on Spatial Distortions of Aerospace Images of Earth's Surface

[Article by A. V. Belokhvostikov, scientific specialist, and V. M. Orlov, doctor of physical and mathematical sciences, "Okean" Main Center, All-Union Scientific Research Institute of Sea Fisheries and Oceanography; Ye. V. Bulychev and I. V. Mishin, candidates of physical and mathematical sciences, All-Union Scientific-Technical Information Center]

[Abstract] A method is proposed for taking into account and estimating the atmospheric influence on aerospace videoimages of the Earth's surface. The influence of the atmosphere is estimated by a comparison of the brightness distribution of reflected radiation with stipulated statistical characteristics at the level of the Earth's surface with the similar brightness distribution at the input of the optical observation system. The two-dimensional albedo of the surveyed feature is simulated by the shaping filter method using a priori information on underlying surfaces. Radiation transfer in a scattering medium is described by the optical transfer operator of a model atmosphere. An example is given to illustrate application of the proposed method. Numerical simulation made it possible to obtain quantitative expressions making it possible to draw practical conclusions on the magnitude of distortions of real aerospace images for a given optical state of the atmosphere. The method can be used for a wide range of classes of images and the estimates made on their basis make it possible to obtain necessary information on the influence of the atmosphere on the spatial structure of images in formulating problems dealing with research on the Earth's natural resources by means of a space survey. Figures 5; references; 12 Russian.

UDC 551.510.534(215 x 17)

Long-Period Variations and Trends in Total Ozone Content in Northern Hemisphere

[Article by V. E. Fioletov, Central Aerological Observatory]

[Abstract] When estimating variations in total ozone content in the zone 45-70° it is necessary to use data from the USSR ozonometric network because in this latitude zone all foreign stations are in a sector with a width 120°. However, in foreign publications USSR data are either ignored or data for only 17 stations are used, although there are 45 stations in the USSR. Accordingly, a study was made using data for all these 45 stations outfitted with M-83 instruments, as well as 44 northern hemisphere stations and 6 southern hemisphere tropical stations outfitted with a Dobson spectrophotometer. The data were analyzed by the procedure of approximation by spherical functions for the period 1974- 1986. The low total ozone content observed early in 1983, in the spring of 1985 (in the temperate latitudes) and in the winter of 1985-spring of 1986 (in the polar regions) led to an evaluation of the linear trend for the northern hemisphere of -1.4% for 10 years with a standard deviation 0.9%. Quasibiennial variations of total ozone content are manifested most strongly in the winter months. The mean monthly total ozone content values for January in the polar regions vary by 30-40 Dobson units, depending on the direction of the equatorial wind at 50 gPa, whereas in other seasons the difference is several Dobson units. Figures 3; references 15: 3 Russian, 12 Western.

UDC 551.510.534(215 x 17)

Northern Hemisphere Atmospheric Ozone Anomaly in 1982-1987

[Article by A. Kh. Khrgian, professor, Moscow State University]

[Abstract] Observations of ozone, its total quantity and profiles, generalized in this article, clearly indicate that the winter-spring ozone anomalies in the northern hemisphere during the period 1982-1987 were global, similar in its eastern and western parts, from time to time only excluding some longitude regions. They were also propagated into the Pacific Ocean, and attenuating, into the low latitudes. These anomalies decreased gradually from 1983 to 1987. The ozone changes in them were not entirely regular. In general they were more prolonged and far more extensive, but considerably weaker than the spring ozone anomalies in the south polar region. A dependence of global ozone changes, including rapid changes, on variations in circulation was demonstrated. The anomalies, in contrast to the southern hemisphere, were clearly unrelated to the polar night and were not caused by anthropogenic pollution of the atmosphere. Ozone observations revealed that the ozone concentration decrease occurs in the lower part of its layer, below 21 km, and sometimes attains -73%. A second layer of decrease, between 11 and 13 km, is probably dependent on the arrival of a tropical air mass. Since the anomalies are manifested in the lower part of the ozone layer, controlled by dynamics, the reason for the anomalies must be attenuation of the meridional transport of ozone from the tropical zone into the high latitudes. Earlier an effort was made to attribute ozone changes to quasibiennial circulation, changes in winds in the tropical stratosphere and periodic ozone accumulations in a region of descending movements, but none of these hypotheses explain the brevity of the anomalies or their progressive southward propagation. Figures 2; references 10: 4 Russian, 6 Western.

UDC 551.510.534

Variations of Stratospheric Ozone in Polar Latitudes

[Article by O. N. Borisov, V. M. Demkin, Yu. Yu. Kulikov, V. G. Ryskin, V. N. Shanin and V. M. Yurkov, Applied Physics Institute, USSR Academy of Sciences]

[Abstract] At present little information is available on ozone content in the high latitudes, primarily due to the absence of continuous observations under polar night conditions. This gap in information can be filled only by the combined use of different methods. The article gives the results of observations of the behavior of ozone in the polar atmosphere made using a microwave ozonometric apparatus developed at the Applied Physics Institute. It is based on observations of the resonance lines of the rotational spectrum of O_3. Passive remote sounding was carried out at millimeter waves, making possible continuous monitoring of stratospheric ozone. Seasonal, diurnal and brief changes of ozone content were registered. It was found that in the polar latitudes of the Arctic there is a considerable ozone loss in the altitude region 22-30 km, occurring sporadically on individual days under polar night conditions. There are rapid (about 1 hour) variations in ozone content in the polar stratosphere which are possibly associated with dynamic processes exerting an influence on its vertical distribution. Figures 2; references 13: 4 Russian, 9 Western.

UDC 551.588.7

Future Probability of Anthropogenic Climate Change

[Article by M. I. Budyko, corresponding member, USSR Academy of Sciences, State Hydrological Institute]

[Abstract] The many aspects of the global warming problem are reviewed. Recently considerable attention has been devoted to the possibility of the appearance of aridization of extensive regions under the influence of global warming. It has been proposed that the release of carbon dioxide and other greenhouse gases into the atmosphere be restricted by reducing the combustion of fossil fuel. However, if it is true, as indicated by available data, that a worsening of moistening conditions has already occurred in certain regions, beginning from the first quarter of the 21st century moistening conditions will improve everywhere. This makes doubtful the desirability of implementation of extremely costly measures for a substantial change in the present-day energy balance for the purpose of slowing or ending global warming during coming decades. It seems inevitable that in the more remote future the increase in mean temperature will cease due to a reduction in the percentage of fossil fuel in the energy balance. In case of need for stopping the warming process it will be possible to modify climate artificially. Quite detailed information is now available on the climate changes anticipated over a considerable part of the northern hemisphere and this can be used in solving many practical problems. These data are being used successfully in long-range planning of the national economy. However, materials on future climate are inadequate for reliable validation of a global plan for the development of energy resources ensuring preservation of favorable climate conditions. This dictates a considerable broadening of research now being carried out on the anthropogenic change of climate for checking, supplementing and obtaining more detailed information on climate of the future and validation of plans for the development of economic activity which will not allow dangerous changes in climate. References 9: 8 Russian, 1 Western.

UDC 551.510.41:551.510.522(262.5)

Ozone, Chlorine, Hydrogen Sulfide and Sulfur Dioxide in Near-Water Layer of Atmosphere Over Black Sea

[Article by B. F. Andryushchenko and A. I. Ryabinin, candidate of chemical sciences, Sevastopol Division, State Oceanographic Institute]

[Abstract] The first determinations of the content and distribution of O_3, Cl_2, H_2S and SO_2 in the near-water layer of the atmosphere over the open waters of the Black Sea, highly important in evaluating the ecological state of this region, are described. This information was collected during periods of multipurpose expeditions. Air samples were taken from a level 2-4 m above the surface using several types of gas analyzers during 1985- 1987. Data were obtained on the concentration of the mentioned gaseous compounds, making it possible to estimate their spatial-temporal variability. The distinguishing characteristics of daily variations of the O_3 concentration over the Black Sea surface were clarified relative to their variability over the land. The influence of pollutants on O_3 content in the air was evaluated. It was observed that the O_3 concentration and its gradient in the air layer 0-3 m above the water surface are essentially dependent on the presence of petroleum products and their concentration in the surface layer of the sea. The Cl_2 content over the Black Sea considerably exceeds that observed earlier over the ocean; its mean daily variation is in antiphase with the mean daily variation of O_3 content. It is postulated that the appearance of high Cl_2 concentrations over the Black Sea is a result of anthropogenic activity. Figures 2; references: 3 Russian.

UDC [551.583:551.588.7].001.24

Empirical Evaluation of Impending Climate Changes

[Article by M. I. Budyko, corresponding member, USSR Academy of Sciences, State Hydrological Institute]

[Abstract] During recent years a semiempirical method has been developed for evaluating climate conditions of the future. An effort has now been made to transform this method to a purely empirical method, completely independent of computations of the anthropogenic change in climate conditions made using climate theory models. The possibility of using models of climate theory and the empirical method for predicting changes, two completely different approaches to solution of the problem of anticipated climate changes, can considerably increase the reliability of information on climate conditions of the future. The rapid development of modern anthropogenic heating dictates that there must be the maximal possible acceleration of the organization of work for improving the empirical method for estimating the anticipated climate changes, especially an increase in the accuracy and detail of paleoclimatic maps used as analogues of climate conditions in the future. There is a need for developing a method of paleoclimatic analogues of maps of the principal climate elements for the time period 2000-2050 for all populated continental regions. A method must be developed for constructing maps of impending climate changes for the relatively

near future, applicable to the Earth's entire surface, by the method of extrapolation of data on anthropogenic warming after 1975. There is need for a detailed comparison of climate conditions of the future determined empirically and using models of climate theory for developing a synthetic approach to solution of the future climate problem. An organization must be formed for ensuring that the findings of such research be disseminated rapidly and widely to the scientific community. References 15: 11 Russian, 4 Western.

Another SOS From Antarctica

*907N0050 Moscow NTR: PROBLEMY I RESHENIYA
in Russian No 21, 3 Nov 89 pp 1-2*

[Interview with Central Aerological Observatory Deputy Director V. Khattatov by O. Lebedeva]

[Text] An alarming situation evolved over Antarctica this fall. Within a few weeks the thickness of the ozone layer dropped almost to the critical level of October 1984. The sun's ultraviolet rays are scorching the continent, which has been deprived of its atmospheric protection. In the next few months, as ordinarily happens during the South Pole's winter, the ozone hole will grow larger.

We offer to the reader's attention an interview with Central Aerological Observatory Deputy Director V. Khattatov, the leader of the Soviet part of the joint Soviet-American program for studying the ozone layer.

Lebedeva: Vyacheslav Useinovich! Our newspaper has carried articles several times on the dynamics of the ozone anomaly above Antarctica, and on the problems associated with it. In particular we reported to readers that the dimensions of the ozone hole were smaller last year that the year before last. How do matter stand now, in the present Antarctic spring?

Khattatov: The situation gives cause for concern, it is much worse than last year. The scale of the hole right now is such that even Soviet coastal stations located on the continent's periphery reveal a very sharp decline in the ozone concentration of the stratosphere—by 30-40 percent. Moreover such a pattern is observed all over Antarctica. And after all, it was just a few years ago that the decrease in ozone concentration occurred only in its central part.[1] In the meantime coastal stations in the Soviet sector of Antarctica showed that even if such a trend existed, it was insignificant.

The depth of the present hole is practically the same as in 1987, when the ozone concentration fell to 120 Dobson units. Its spacial dimensions are greater that last year.

Lebedeva: Where do you get information by which to assess the state of the ozone layer?

Khattatov: First of all, from Soviet Antarctic stations. Besides that, additional information has recently been coming from several scientific research vessels. We learn with their assistance what is happening at different latitudes of the World Ocean near Antarctica. Shipboard scientific programs also have the objective of testing all kinds of hypotheses. For example, this one: May the ozone be redistributing itself dynamically into other regions? If this is so, you see, then the total quantity of ozone in the earth's atmosphere is not decreasing, and weakening of the ozone layer above Antarctica does not yet mean that it is being subjected to chemical destruction precisely in that place.

Nonetheless the experimental data persuade us more and more that the ozone is undergoing destruction, and not redistribution.

Lebedeva: What is the cause of the atmospheric anomaly above Antarctica?

Khattatov: There are few opponents left to the anthropogenic hypothesis on the ozone layer's destruction. Many of those who initially sided with the idea that the ozone hole is of natural origin now also assert that the main cause is human activity, the enormous quantities of chlorine-containing industrial wastes discharged into the atmosphere. This is obviously a global process of anthropogenic action upon nature.

Our associates from the USA's National Aeronautical and Space Agency came to this conclusion as well; using a Nimbus-7 satellite carrying a TOMS instrument, they are receiving the current global pattern of the ozone concentration not only within the region beneath the satellite but also over the continent as a whole.

Lebedeva: And if the ozone quantity becomes increasingly smaller, what have we to expect?

Khattatov: The ozone anomaly will apparently exist for another dozen years even if we were to sharply reduce discharge of chlorofluorocarbons into the atmosphere. They have already accumulated there in large quantities, and they will continue to break down and release chlorine for a long time to come. But it is impossible to abruptly halt the process of contamination, since chlorofluorocarbons are an entire direction of chemical industry.

This graph [graphic not reproduced] of the altitude distribution of ozone was plotted on the basis of data from experimental research on the atmosphere above Antarctica at Mirnyy Station. The normal ozone concentration in the stratosphere at these latitudes is 330 Dobson units (a Dobson unit is used to assess the concentration of atmosphere ozone). As is shown in the figure, in this Antarctic spring (August-October) the level of stratospheric ozone dropped in September to 200 Dobson units, and in October to 167 Dobson units.

It is not just in refrigerators, deodorants and hair sprays that it is used. It is used primarily in the production of porolon, polyethylene, foam plastic (including an enormous quantity of plastic packing material), porous material for footwear, and so on.

Use of chlorofluorocarbons in large volume is not a whim. They are truly noncaustic, nontoxic, and relatively harmless to people and the environment. The only problem is that they break down in the high layers of the atmosphere, releasing chlorine, which is what deprives the earth of its ozone protection.

Were the requirements of the Montreal Protocol[2] on substances breaking down the earth's ozone layer to be fulfilled, the concentration of chlorine in the atmosphere would probably stop growing, and it may possibly even decrease in the remote future. But for the moment the situation remains very alarming, since far from all states have recognized the threat, and have signed this international treaty. In particular, many developing countries intend to expand production using chlorofluorocarbons. And this means that on the whole, the ozone concentration above the planet will fall.

And then the hole may grow larger, like a cancerous tumor, affecting ever-larger areas, and "scorching" continents such as Australia and South Africa. Not only may the hole widen, but it may also lose increasingly more ozone within itself.

Lebedeva: Can't it be "patched" in some way, chemically for example?

Khattatov: Such ideas do arise. For example launching substances into the atmosphere compensating for the ozone shortage has been proposed as a way of closing the hole. This is a very bold and interesting approach to the problem in the scientific aspect. But it is impossible to seriously talk about the need for practically implementing such a project today. You see, we do not yet fully understand the internal dynamics of the development of this artificial process. On the other hand there is considerable woeful experience in invading into global natural processes—for example cutting Kara-Bogaz-Gol off from the Caspian Sea at the strait in the hope of saving this sea.

Consequently what we need to do primarily is observe the principle of not doing further harm. And the optimum strategy here is to remove the source of pollution itself, to halt the discharges, and not to try to compensate for them.

But if it turns out that mankind has now released a critical quantity of chlorine into the atmosphere, and that the slightest bit more would destroy the earth (fortunately neither theoretical calculations nor experimental data suggest this at the moment), that would be the time to think about a compensatory effect in the practical aspect as well.

Let me emphasize once again: In principle, we can generate a sufficient quantity of ozone in the atmosphere. But it is extremely difficult to answer the questions as to how safe such a project would be, how difficult it would be to implement it, and whether or not mankind could afford it. It would probably turn out to be a very expensive thing. But even here, what should be paramount is not the cost but the suitability of the project.

Lebedeva: Does this mean that you feel that the sole reasonable means of stopping depletion of the ozone layer today is to halt discharges of chlorine-containing substances into the atmosphere?

Khattatov: I am certain that it is the sole means, and moreover that it is fully possible, which is what is considered by the Montreal Protocol. Realizing the inevitability of banning chlorofluorocarbons, the industrially most developed countries are striving to do away with the need for using them, as quickly as possible. After all, refrigerators and other goods requiring these substances will very soon become noncompetitive in the marketplace. Meaning that our industry should hurry as well, even though this will require considerable assets.

Lebedeva: The first successes have already been recorded. For example, the Gosudarstvennyy Institut Prikladnoy Khimii Scientific-Production Association synthesized two substitutes for chlorofluorocarbons that are practically harmless to stratospheric ozone. The new substances are already undergoing testing.

Khattatov: Yes, harmless production procedures are already being developed and tested. But their introduction is a longer and more painful process. The ozone hole problem does not of course mean that we should abandon chlorofluorocarbons completely. But wherever we can't do without them, we must exclude the possibility of discharges: We need to create closed production cycles, and foresee successive regeneration of chlorofluorocarbons. There is still time to carry out the appropriate research.

Nonetheless I am certain that 15 years from now mankind will forget about the existence of chlorofluorocarbons. This is not a fantasy. When it was learned some time ago, after all, that DDT is a strong poison, its use was halted. Depletion of the ozone in the atmosphere is a no less threatening problem.

I feel that we need to think not so much about the ozone hole over Antarctica itself, as about the fact that it is a real signal for action. That if we do not react to it in the future either, if we continue to discharge chlorofluorocarbons, something terrible may happen. Successive accumulation of chlorine is capable of causing depletion of the earth's entire ozone layer. In the Northern Hemisphere, the ozone concentration has decreased at all latitudes by 6-8 percent in winter months of the last 17 years.

If we compare this with the ozone hole, this does not seem to be very much. But the decrease is a stable trend. What will there be above the planet 50 years from now? How will our children live? This means that there is more than just the ozone hole that should be troubling us.

A large expedition of American and Soviet scientists recently visited the Arctic. Fortunately it was found that the atmosphere there is in order. But what it will be like 2-3 years from now is still unknown. And if ozone anomalies begin there as well, this will be much more serious than in Antarctica. Regions in which the population of the USSR, Scandinavian countries, Canada and America lives will be threatened.

Lebedeva: How well are our country's highest organs of government informed about the state of the atmosphere?

Khattatov: They have all of the information. A few months ago, for example, the USSR State Committee for Hydrometeorology, the USSR Ministry of Chemical Industry, and a number of other ministries and departments possessing enterprises that use or produce chlorofluorocarbons sent an appeal to the USSR Council of Ministers. It contains a request to support, at the level of a government program, industry's transition to new production procedures and development of scientific research in this direction.

The Montreal Protocol particularly foresees reducing chlorofluorocarbon production by the late 1990s to an amount less than half of the 1986 level. And inasmuch as our government not only signed but also ratified this agreement, it must be fulfilled. And this will require considerable assets and efficient control of the process of Soviet industry's transition to new production procedures.

Footnotes

1. See NTR, No 22, 1988.

2. See NTR, No 1, 1989.

UDC 551.521.3:551.510.42

Radiation Effects of Arctic Aerosol

[Article by M. I. Dolgin, I. L. Karol and Ye. V. Rozanov, Main Geophysical Observatory; Arctic and Antarctic Scientific Research Institute]

[Abstract] The aerosol in the arctic atmosphere has specific parameters in comparison with aerosol in other geographical regions. The turbidity of the arctic atmosphere is increasing due to man's economic activity. The article gives a generalization of the results of measurements of the optical properties in the Arctic, on the basis of which, using a radiative-convective model, an evaluation was made of the influence of arctic aerosol (haze) on radiative transfer and thermal structure of the arctic atmosphere in spring (during the period of maximal turbidity) and in summer. It is shown that background arctic aerosol makes no substantial contribution to formation of the thermal regime of the atmosphere. In spring the appearance of arctic haze, characterized by a substantial anthropogenic component, causes strong radiative heating commensurable with the effect of a doubling of CO_2. A more detailed study of the influence of aerosol on arctic climate in the future will require use of two- and three- dimensional climate models, as well as a climatic analysis of observational data and estimates of the intensity of interlatitudinal transfer. Figures 4; references 19: 8 Russian, 11 Western.

UDC 551.583:551.588.7

Anticipated Anthropogenic Changes in Global Climate

[Article by M. I. Budyko, N. A. Yefimova and I. Yu. Lokshina, State Hydrological Institute]

[Abstract] It is possible to estimate the increase in mean global temperature for the coming 20-25 years with an error substantially less than the anticipated temperature change. For the more remote future the probable errors in such computations will undoubtedly increase. However, there is basis for assuming that approximately up to 2030-2050 the estimates of increase in mean temperature will have the correct sign and order of magnitude and the errors in these estimates will not exceed 50% of the anticipated temperature change. Such a conclusion can be drawn from an analysis of errors in taking into account the main factors exerting an influence on temperature change. With respect to the accuracy in estimates of impending regional climate changes, this accuracy is easier to estimate for the temperature of the lower air layer, whose regional changes can be determined by several independent methods. Evaluation of the error in determining changes in precipitation quantity is more difficult. However, even after a few years it will be possible to use observational data for a far more detailed comparison of the spatial-temporal structure of the temperature and precipitation fields during the most recent warming stage (approximately since 1975) with estimates of the anticipated climate change at the end of this century based on paleoclimatic analogues. Consistency between observational data for the climate change now transpiring and such a prediction will considerably increase trust in the reliability of similar predictions for the coming decades. Figures 7; references 21: 14 Russian, 7 Western.

UDC 504.3.054/.4.054:547.91(99)

Background Concentrations of Low-Molecular Chlorinated Hydrocarbons in Antarctic Atmosphere and Snow Meltwater

[Article by P. Ye. Tulupov, professor, A. I. Kochetkov, M. A. Zapevalov, candidate of chemical sciences, N. F.

Lapina, candidate of biological sciences, S. I. Fedulov and G. B. Savitskiy, Tayfun Scientific Production Association]

[Abstract] Information is given on use of a method for gas chromographic determination of low-molecular chlorinated hydrocarbons in the air and snow meltwater for obtaining experimental data on the level of pollution of air and snow in Antarctica from April 1985 through February 1986. The air sampling was carried out at a point 1000 m from Molodezhnaya, 1 m above the land surface. The experimental results made it possible to determine the background concentrations of $CHCl_3$, CCl_4, C_2HCl_2 and C_2Cl_4 in the atmospheric surface layer in Antarctica. In snow meltwater the concentration of components remained virtually constant during the entire period of observations. In September in the atmospheric surface layer there are clearly expressed maxima exceeding the global concentration of $CHCl_3$, C_2HCl_3 and C_2Cl_4 by a factor of 5-9. The CCl_4 content, however, is approximately constant. The appearance of maxima is attributable to the special features of synoptic processes in the southern hemisphere. Figures 2; references 9: 6 Russian, 3 Western.

Influence of Ground Dumping on Quality of Marine Environment and Biota

[Article by Ye. N. Shapovalov, A. V. Tkalin, candidate of geographical sciences, and V. L. Klimova, candidate of biological sciences, Far Eastern Regional Hydrometeorological Scientific Research Institute]

[Abstract] Data are presented on the volumes of entry of some pollutants into the sea: petroleum hydrocarbons, heavy metals and suspended matter. In situ and experimental data are used in defining some patterns of behavior of dumped materials under different hydrometeorological conditions. The dumping of ground extracted during dredging work in port areas and in coastal shallow waters without any water protection measures results in pollution and silting of bottom deposits having a negative effect on the quality of the water body, changing the benthos environment. The scales of the influence of dumping on the quality of the sea medium are highly dependent on hydrodynamic conditions and morphometry in the dumping area. The finely disperse ground fractions may be deposited at a distance 10-15 km from the dumping site. The influence of dumping on biota is expressed in a general decrease in the biomass of benthos in the dumping area and reduction of the original number of species to one-five tolerant species. Changes in benthos biocoenoses are traced at a considerable distance in the direction of the predominant currents. In order to make a thorough evaluation of the ecological state of the sea in dumping areas the monitoring system must include observations of the hydrochemical, hydrophysical and hydrobiological parameters of the sea medium with the use of in situ and laboratory experiments, precise bathymetry and numerical modeling of the dumped material under different hydrometeorological conditions. It is proposed that the zone of influence of dumping on the bottom population be determined using five characteristic species of polychaetes. References 7; 6 Russian, 1 Western.

Research on Anthropogenically Induced Middle-Atmosphere Ozone and Temperature Variations

[Article by I. G. Deminov and E. I. Ginzburg, Novosibirsk State University; West Siberian Regional Hydrometeorological Scientific Research Institute]

[Abstract] A one-dimensional nonstationary radiative-photochemical model was used in estimating possible changes in ozone and temperature in the middle-latitude atmosphere in the altitude range from 0 to 55 km in connection with anthropogenically induced disturbances caused by change in the content of CO_2, CH_4, N_2O, NO_2, $CFCl_3$, CF_2Cl_2 and CCl_4. It is shown that the joint influence of all the considered disturbances is not additive and leads to essentially lesser ozone and temperature variations. The investigation of the discovered nonlinear effect indicates that its special features are attributable to the complex nature of the interrelationships among the radiative and photochemical processes in which a significant role is played by temperature feedbacks. The spatial and temporal variations of ozone and temperature up to 2080 are predicted for one of the possible scenarios of change in atmospheric composition. Figures 4; references 16: 8 Russian, 8 Western.

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